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Locomotives:

S. A. L. "Silver Meteor" 127
Locomotive Slipping Tests 132

Cars:

Passenger Cars Air Conditioned During 1938 139
Wet-Bulb Thermostat Controls Air-Conditioning Unit 142
Apex Safety-Steel Running Board 143

Editorials:

Some Light on Deferred Maintenance 145
Fewer Machine Tools and Tool Supervisors 146
Nine Years Progress in Railway Air Conditioning 147

New Books 147

Reader's Page:

Exchange Ideas on Equipment Maintenance 148
Compensation for Worth-While Ideas 148

Back Shop and Enginehouse:

Permanent Type Magnetic Chuck 149
Hydraulic Pipe Bending Machine 149
Old Dog—New Tricks (A Walt Wyre Story) 150
Bench Miller for Cutting Piston Rings 153
Crane Harness Sling Rack 153
Locomotive Boiler Questions and Answers 154
Pulsation Dampener for Gages 155

Car Foremen and Inspectors:

Box Car Repairs with Small Working Force 156
Compressor Repair Stand and Boring Bar 158
Pneumatic Rack for Compressing Springs 159
Mechanical Sanding and Rubbing Machine 159
Air Brake Questions and Answers 160

High Spots in Railway Affairs 161

Clubs and Associations 162

News 163

Index to Advertisers ..... (Adv. Sec.) 34

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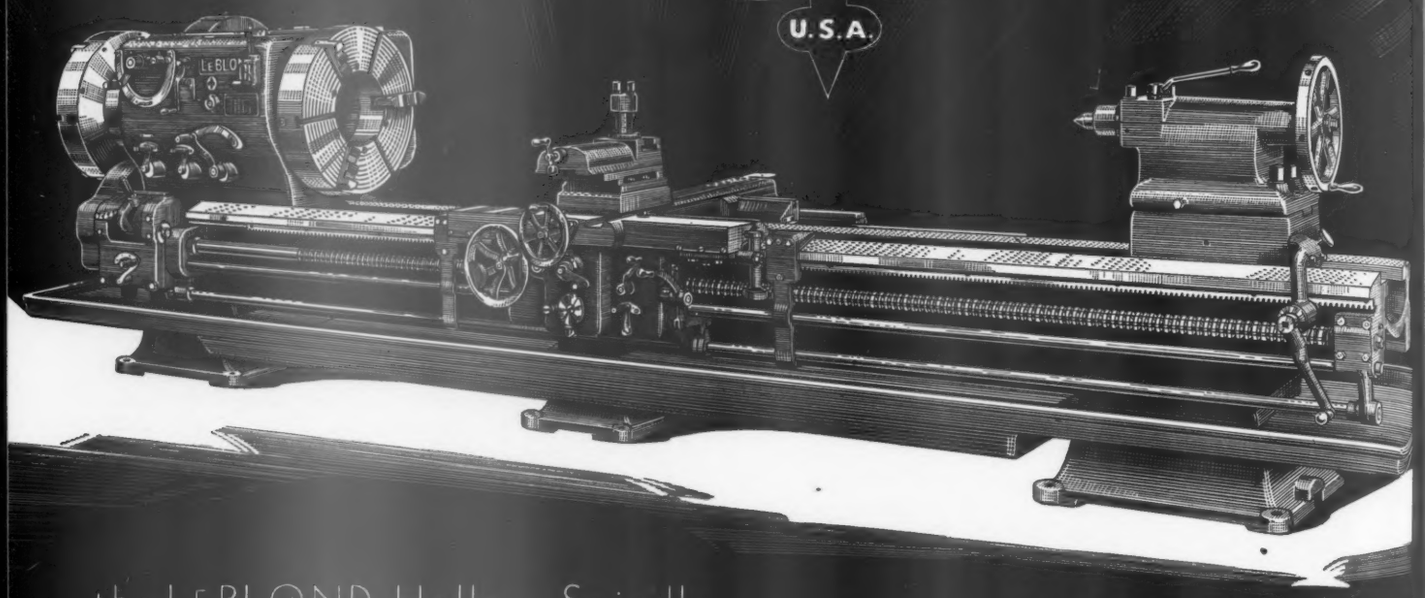

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The Seaboard Air Line "Silver Meteor"

The Seaboard Air Line Inaugurates

The "Silver Meteor"

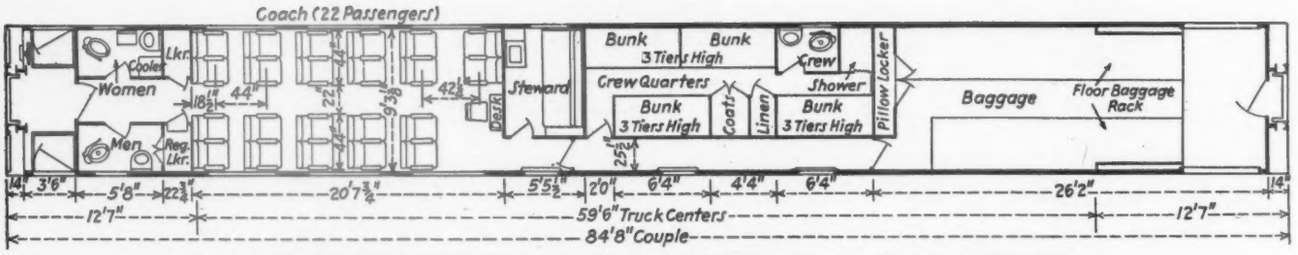
Budd-built stainless-steel streamline train provides seats for 280 coach passengers in New York-Florida service—The train is hauled by an Electro-Motive 2,000-hp. Diesel-electric locomotive

ON February 2 the Seaboard Air Line inaugurated a de luxe chair-car service between New York and Florida when the "Silver Meteor" made its first southbound trip to Miami. The train consists of seven air-conditioned cars of lightweight stainless-steel construction, built by the Edward G. Budd Manufacturing Company. It has reclining chair-car seats for 280 passengers. The facilities include dressing-room lounges for men and women, a diner, a tavern, and an observation-lounge. The train is handled by a Pennsylvania electric locomotive between New York and Washington. From Washington to the southern termini the motive power is a 2,000-hp. Diesel electric engine built by the Electro-Motive Corporation. The train makes a round trip each three days, alternating between New York and Miami and New York and St. Petersburg.

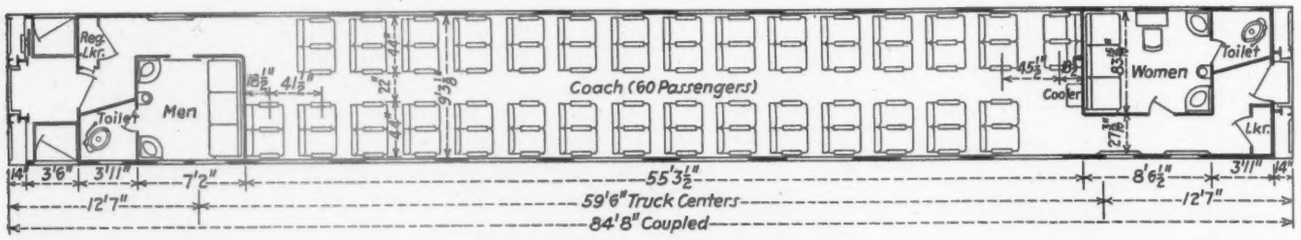
The Structures and Mechanical Features

This train of stainless-steel construction, welded to form an integral unit by the Budd Shotweld method, has stainless-steel end underframe and body bolsters, and a stainless-steel center sill of unusual strength extending between the end sills. This center sill is built up of stainless-steel shapes drawn from sheets of ¼-in. and 3/16-in. material. It has a cross-sectional area of 18.06 sq. in. and is designed to take a buffing load of 900,000 lb. within the limits of working stresses. The sill is symmetrical about both its horizontal and vertical axes and the line of draft falls on the center of gravity of the cross-section. The floor structure consists of beams, stringers, and corrugated floor sheets, all integrally welded together and to the truss-type side frame. The roof and skirt sheathing is corrugated high-tensile stainless steel, the deadlight panels are flat panels of soft finish, the rails are brightly polished, and the area below the belt rail is fluted panels, all of which form an attractive exterior of various finishes of the stainless steel. The railroad name is painted on the letterboard name plate and the car numbers are etched on a satin-finish stainless-steel plate in the fluted panel area.

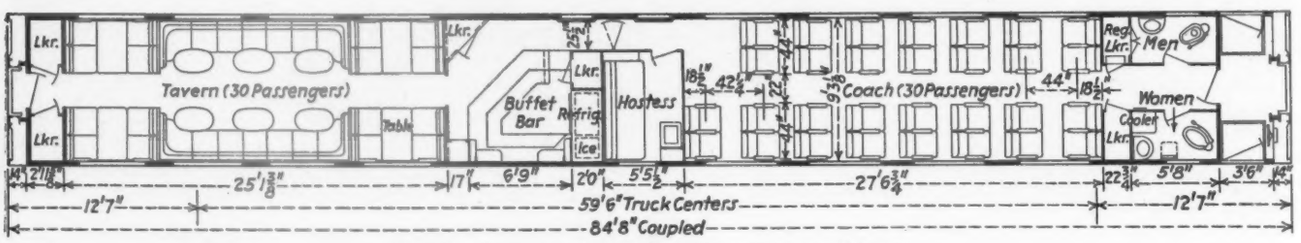
The diaphragms of stainless steel have an inner telescoping arrangement sealed all around with canvas. The outer diaphragm of rubber is held taut by a frame hinged



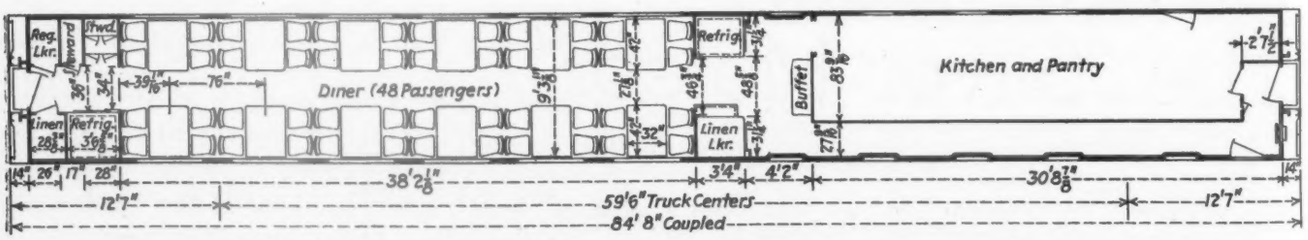
The baggage-chair car contains a steward's room and sleeping quarters for a crew of twelve



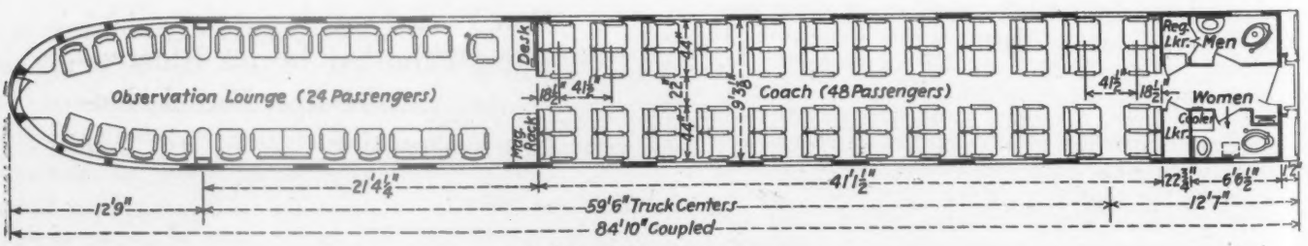
One of the three sixty-passenger coaches



The chair-tavern car — The hostess' room is in this car



Each table in the diner seats four



The chair-observation-lounge car

from the face plate to give a continuous streamline appearance. At each vestibule there is a swing-out sign with the car designation number for the guidance of passengers when the train is at a station. The vestibule steps, when in the closed position, retain the continuity of the exterior sheathing.

All the cars are non-articulated and have four-wheel, double-equalized trucks with 9-ft. wheel base, Timken roller bearings, General Steel castings, unit frames, Houde shock absorbers and rubber sound deadening at vital points. Wheels and axles were furnished by the Bethlehem Steel Company. The wheels are 36 in. in diameter. With the exception of the leading truck of the combination baggage-chair car and both trucks of the dining car, which have 6-in. by 11-in. journals, the journal sizes are all 5½ in. by 10 in. The maximum axle load on the most heavily loaded 6-in. by 11-in. truck is slightly less than 36,000 lb.; on the 5½-in. by 10-in. trucks it is under 30,000 lb. The trucks are fitted with Simplex unit cylinder clasp brakes and automatic slack adjusters. National tight-lock couplers and double-acting rubber-type draft gears assure smooth starting without passenger discomfort.

The cars are equipped with New York D-22-A auto-

matic passenger brake equipment. This equipment includes the D-22-A control valve and the A-4-A relay valve. With foundation brake rigging designed to provide the required high braking force for ultra high-speed service the A-4-A relay valve normally functions to provide the standard maximum braking ratio of 150 per cent for conventional passenger service, but permits the later adoption of high-speed features with a minimum of change if this becomes desirable.

Each car has a Safety 20-kw. body-hung, axle-driven generator and Exide 32-volt, 1,000-amp.-hr. batteries carried in stainless-steel battery boxes. Hinged skirt panels permit access to the under-car apparatus for servicing. Standby receptacles provide for battery charging and operation of the air-conditioning apparatus at terminals.

All passenger sections are air conditioned with Frigidaire electro-mechanical apparatus and the car bodies are insulated with Stonefelt throughout. The compressor equipment is located beneath the floor of the car and overhead is mounted the combination cooling and heating unit. The conditioned air is distributed by an overhead duct with diffusers. Fulton Sylphon thermostatically controlled side-wall radiation supplements the overhead heating unit. Barco insulated flexible steam-heat connections are installed between the cars.

The water supply is carried in stainless-steel tanks under the car which are serviced from filling plugs at the side.

Interior Arrangements of the Cars

All cars are 84 ft. 8 in. in length, coupled, except the observation car which is 84 ft. 10 in. The train consists of—

Car. No.
1—Baggage-chair car
2—60-passenger chair car
3—Chair-tavern car
4—48-passenger diner
5—60-passenger chair car
6—60-passenger chair car
7—Chair-observation lounge car

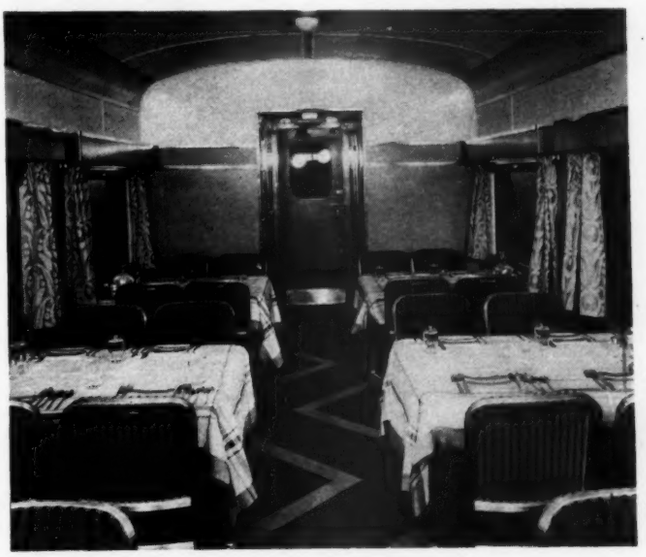
There are 280 revenue seats, 120 non-revenue seats in the diner, tavern, observation lounge, and chair-car lounges, and sleeping accommodations for a crew of 14.

The first car has a 26-ft. 2 in. baggage compartment with letter case and drop-leaf desk, and at the rear is a locker for the storage of pillows. The side lining of the baggage compartment is corrugated steel sheets above which on the side ceiling are flat steel sheets and a tempered Masonite top ceiling. The ceiling is painted white, the side walls buff and the hardware black.

Back of the baggage section is the crew's quarters with sleeping accommodations for 12 men in bunks three tiers high. The facilities include a shower bath, toilet and washing facilities, wardrobe and linen lockers. The shower stall is lined with stainless steel and the floor consists of a rubber mat on a wood rack set in a stainless-steel drain pan. The steward has a private stateroom with complete toilet and sleeping accommodations. Wall sockets permit a folding type table to serve as a desk.

The balance of this car is a 22-passenger chair section with a conductor's desk at the forward end and men's and women's toilet rooms at the rear.

Car No. 2 is a 60-passenger chair car with the vestibule forward and has large men's and women's lounges at opposite ends of the car. Against the partition of the women's lounge is a console-type electric water cooler, presenting an attractive setting with a photo mural above. Cars Nos. 5 and 6 are duplicates of No. 2, except for the direction of operation of No. 5.



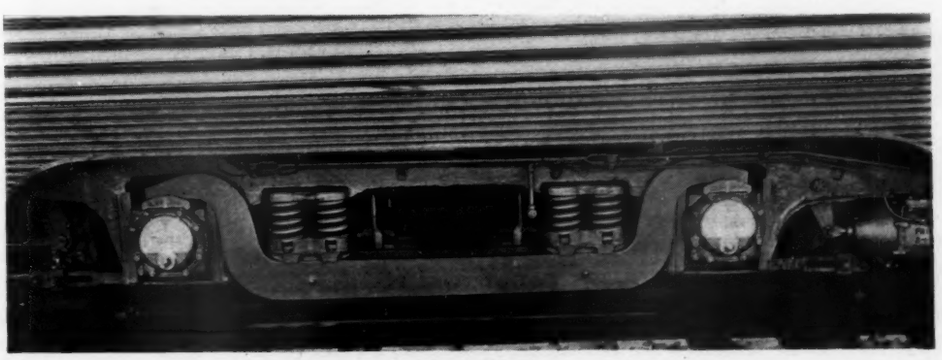
The dining car

Car No. 3, the chair-tavern car, has a 30-passenger chair section with toilet rooms and vestibule forward. The room for the hostess at the rear has sleeping and toilet equipment similar to the steward's room of car No. 1.

The tavern section has two longitudinal settees, each with three pedestal-type tables. Forward and back of the settee on either side are pairs of facing seats with a table arranged for card playing.

Lighting is by three-unit and two-unit ceiling fixtures and built-in lights over the windows.

The bar at the front of this section has decoratively



One of the four-wheel equalized trucks

etched gun-metal back-bar and side-bar mirrors with diffused side lighting, glass shelves, a black rubber bar top and black molding. It is equipped with electric refrigeration and has a concealed radio to supply music for the patrons of the tavern section.

The diner, car No. 4, seats 48 at double tables, six on each side of the aisle. The chairs have aluminum frames. Lighting consists of ceiling fixtures and concealed over-window lighting.

Against the kitchen partition facing the dining room is the buffet with a vertical-grain Caucasion walnut veneer

A coach interior

on the cabinet body and vertical-grain Aricutal-walnut-veneered door and drawer panels. Above is a mirror.

The kitchen has bright chrome-plated piping and fixtures and stainless-steel lining and lockers. Complete equipment for efficient service includes the range with an automatic blower, electric dish washer, electric ice-cream cabinet, sinks, work tables, etc. The kitchen flooring is wood racks set in stainless-steel drain pans. The windows are drop type with opal glass, and a service door permits provisions to be taken directly into the kitchen. From a slot on either side of the entrance to the pantry is blown a curtain of air which is drawn inward by the ceiling exhaust fans. The air curtain prevents food odors from passing into the dining room.

The last car, the chair-observation-lounge, has a 48-passenger chair section with the smaller type toilet rooms forward. The observation lounge has 17 movable satin-finished square-tubular-framed arm chairs, three love seats, and a desk chair.

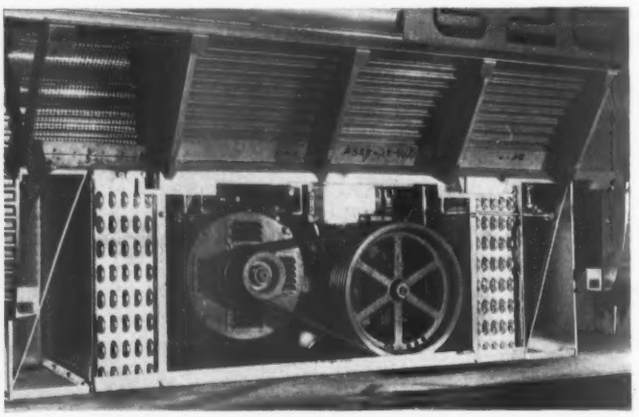
Between the chair section and observation-lounge section is a low partition with decorative plate glass above. Etched in each panel is a large game fish, seen as through the side of an aquarium. Against this forward partition is a writing desk on the left and on the opposite side a magazine rack with a built-in radio. Toward the rear of the lounge are two built-in side tables and on either side of the rear-end doors is a built-in table, one of which conceals the equipment for train back-up movements.

The lighting is by overhead fixtures, continuous cove lighting over the windows and table lamps.

In the passenger sections throughout the train the interior lining is, in general, Masonite. The flooring consists of cork strips set in the corrugated-steel structural

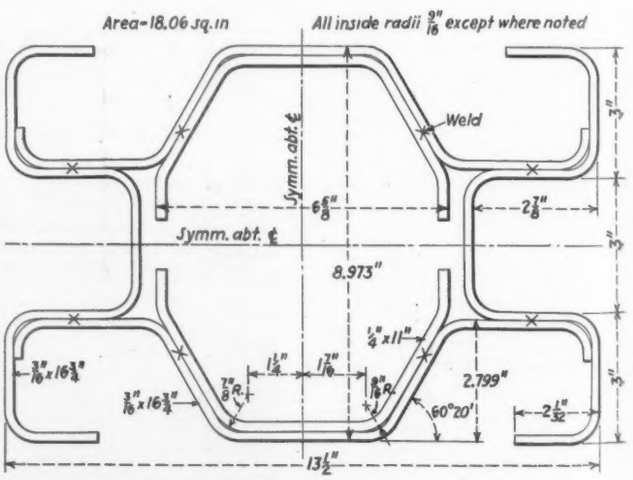
Weights of the Cars in the Seaboard Air Line "Silver Meteor"

	Body		Trucks	Total, ready	Revenue
	Dry wt., lb.	Ready for service, lb.	lb.	to run, lb.	load, lb.
Coach-baggage	69,161	72,911	35,050	107,961	22,900
60-passenger coach ..	66,460	68,130	34,600	102,730	9,000
Coach-tavern	69,911	72,731	34,600	107,331	9,150
Diner	75,312	88,412	35,475	123,887	7,100
Coach-observation ..	63,501	65,171	34,900	100,071	10,802



The air-compressor and condenser unit

floor, on the top of which is one inch of cork which serves as heat and sound insulation. The passenger sections are all fitted with continuous closed-type bag racks, on the under side of which are built-in reading lights, individually controlled by the occupants of each seat. The Heywood-Wakefield seats are rotating and reclining to several positions. They have Dunlopillo foam-rubber seat cushions and backs of hair-filled inner-spring construction, stainless-steel foot rails, and upholstered arm rests. In all of the chair-car sections there are four positions where portable wall-type tables, each with an aluminum-edged rubber-surfaced top, and a folding leg may be set up.



Center-sill cross-section used on the Silver Meteor cars

The window posts are spaced 61 in. apart which permits windows wide enough to accommodate two seats each. All side windows are double glazed with polished plate glass on the outside and laminated safety plate glass on the inside. The sashes are of extruded aluminum and are fitted with moisture-absorbing cartridges to prevent fogging of the inner surfaces.

In all of the coach sections the general lighting is by recessed ceiling fixtures, in each of which is incorporated a small blue lamp to supply a dim, restful light during the night hours. The individually controlled luggage-rack fixtures furnish illumination for reading. All toilets and lavatories are equipped with porcelain wash basins and foot-operated pressure-fed double-pan hoppers, and all exposed piping is chrome plated. Each men's room has a 100-volt a.c. outlet for electric razors and each women's room has a folding drop seat.

Each chair-car section has its own individual color scheme. These are designated as the green, the coral, the brown, the blue, and the pink cars, based on the predominate note in the decorations. Each, however, is made up of a number of harmonizing, but contrasting, tones, involving ceilings, side walls, upholstery, and floor. On the bulkheads at the end of each chair-car section are large photo murals in stainless steel frames. Common to all of the cars are the Pantasote window shades, the inside faces of which are beige, and the floors under the seats, which are in dark oak.

The floors of the tavern, the observation lounge and the diner are carpeted. In these sections the windows are also softened with drapes.

The cars are fitted with tight-lock couplers

The Locomotive

The locomotive for the Silver Meteor is a 2,000-hp. Diesel-electric unit built by the Electro-Motive Corporation, La Grange, Ill. In all of its important essentials it is identical in design to the "A" units of the 6,000-hp. locomotive built by the same company for the Orange Blossom Special which went into service on December 15, 1938.

The power plant consists of two 1,000-hp. General Motors 12-cylinder, two-cycle Diesel engines controlled simultaneously from the main throttle. To each main engine is connected a 600-volt d.c. generator which supplies the electrical energy for the 450-hp. traction motors in the truck directly below each power plant. The electrical equipment was supplied by the Electro-Motive Corporation.

The locomotive is 70 ft. 4 in. long over the coupler pulling faces and weighs 315,700 lb. in working order. This weight is carried on two six-wheel trucks—157,350 lb. on the front truck and 158,350 on the rear truck. The front and rear axles of each truck are geared to the traction motors. The truck assemblies are interchangeable with the locomotives used on the Orange Blossom Special. They weigh approximately 50,000 lb. and have a wheel base of 14 ft. 1 in. The wheels are 36 in. rolled steel and the axles are mounted in Hyatt double-row roller bearings. The truck brake equipment is the clasp type actuated by four 10-in. by 10 in. brake cylinders on each truck.

The locomotive is controlled by three main levers; the main throttle, the reverse lever and the brake handle. The movement of the main throttle controls the speed of the two Diesel engines through an electro-pneumatic device which actuates the speed governor on each engine. Local control stations, consisting of fuel- and lubricating-oil gages and engine speed indicator, permit the checking of engine operation at the engine. At the operator's station in the front cab is a hot-journal and wheel-slip indicator in addition to the customary speed indicator, air-brake and automatic-train-control gages.

Train heat is supplied by a Clarkson type steam generator working at 225 lb. pressure. The feedwater pumps, fire control and train-line pressure regulation is fully automatic and adjusted by a hand rheostat. Steam from this boiler heats the operator's cab and warms the engine water systems during lay-over or maintenance periods.

Results and Conclusions of

Locomotive Slipping Tests*

By T. V. Buckwalter† and O. J. Horger††

In all of the tests made the lifting of the driving wheels was confined entirely to the main pair of wheels and no lifting was observed on any of the other drivers. The suggested explanation for this action being limited to the main wheels at the speeds of testing is: (a) the actual overbalance in the main pair of wheels was always higher than on any other pair (Table III) and (b) the unsprung weight of the main pair of wheels is about 5,000 to 8,000 lb. greater than any other pair (Table IV). A discussion of the influence of these two factors is given later in this paper.

The location of the counterbalance in all these tests was found to be in the up position when the wheel was a maximum distance off the rail. The exact number of degrees that the counterbalance is off from the up vertical position has not yet been analyzed from the moving pictures. It is apparent from the pictures that once the wheels start lifting it is off the rail more than it is on the rail so that the counterbalance may be in almost any position, depending up the degree of lift.

Because of the see-sawing action of the pair of wheels across the rail as it vibrates up and down on the rail, the plane of the wheel is inclined to the rail instead of being vertical. This action may have some significance from the standpoint of what is happening in: (a) driving-wheel fits on axles; (b) stresses leading to failure of wheel centers; (c) axle stresses and failure in wheel fits; (d) misalignment of driving rods from their normal plane of operation, and (e) probable momentary transfer of tremendous forces on the other than main drivers in case of the application of sand.

It is generally confirmed that the engine crews are seldom aware that high-speed slipping is taking place in road service and neither in these slipping tests nor in road service has the crew known that rails were being kinked. In this respect the crews are becoming better acquainted with the handling of such power and wider use is being made of special devices to take care of these operating conditions.

The speed at which the driving wheel just begins to leave the rail is taken from pictures where the first evidence of an intermittent puff of smoke or fire is observed between the wheel and rail. This occurs when the counterbalance is in the down position adjoining the rail. This is an indication of a great change in wheel-rail pressure taking place and was the only means of determining just when the wheel started to leave the rail. Above this speed the wheel lifts off the rail an increasing amount as the speed increases and goes into violent vibration. It is in this latter speed range when rail damage may be produced although between these two speeds a number of marks of various degrees are produced on the rail.

4-6-4 Locomotive Tests

No rail damage sufficient to require replacement occurred in these tests with the exception of the first 4-6-4 locomotive tested, No. 3012, at a slipping speed of 108 m.p.h. Here 39 rails required replacement, the worst kink being ⅛ in. deep as measured over a length of 3 ft. In this test there were a total of 70 impressions on both rails which were produced when the wheel came down and struck the rail and of this total 53 were on the right and 17 on the left rail. These so-called rail impressions varied from 12 in. to 52 in. in length. The depth of these impressions varied from just being visible marks to actual kinks and the breaking of the scale on the web of the rail.

This same locomotive was also tested at one lower slipping speed of 98 m.p.h. and at this speed is was considered as having lifted slightly.

Locomotive No. 3001, which was essentially the same as No. 3012 with the exception that all drivers were equipped with roller bearings instead of plain bearings as on No. 3012 (both engines had heavy reciprocating parts and 315 lb. overbalance) was tested at slipping speeds of 88, 98 and 100 m.p.h. The performance at these speeds was comparable to the No. 3012. Tests on these two locomotives made it apparent that the application of roller bearings on the driving axles had no practical influence on the speed at which the wheels would leave the rail.

Locomotive No. 4003 was used in the third test and the important difference of this engine over Nos. 3012 and 3001 was that the total of the reciprocating weights was only 1,026 lb. as compared to 2,109 lb. In addition roller bearings were applied on all drivers including roller bearing crank pins and lightweight driving rods. Three slipping tests were made at 112, 123 and 128 m.p.h. and the main driving wheels lifted off the rail ¾ in. at 128 m.p.h. and this compares with a lift of ⅞ in. on No. 3012 at 108 m.p.h. The important difference of this test of No. 4003 over No. 3012 was that no rail damage was done on any of these tests of No. 4003. At 112 m.p.h. there were indications that the wheel was just beginning to leave the rails and this compares with 88 m.p.h. found on Nos. 3012 and 3001, to indicate an increase of 27 per cent in speed.

Explanation as to why rail damage did not occur in this test may be found in the fact that on No. 4003 the wheel overbalance constituted a hammer having 103 lb. weight while the No. 3012 had 315 lb. The impact of this smaller hammer was not sufficient to cause rail damage.

4-8-4 Locomotive Tests

Two 4-8-4 locomotives with approximately the same overbalance, but differing in that No. 5623 had 44 per cent less weight of reciprocating parts than No. 5604, were tested. No. 5604, at slip speeds of 93 and 102 m.p.h., showed no wheel lift but at 104 m.p.h. it was believed to have lifted. At the time this locomotive was tested it was believed that the main overbalance was 310 lb., but since the test results did not develop as anticipated and in line with the other locomotives it was decided to weigh the overbalance after the completion of the test when it was found actually to be 125 lb. With

* Part II of the abstract of a paper presented before the New York Railroad Club, in connection with motion pictures, on February 17, 1939.

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†† In charge of railway engineering and research, Timken Roller Bearing Company, Canton, Ohio.

the large percentage of unbalanced reciprocating weights this locomotive proved to be a very bad rider at these test speeds and the general vibration of the entire locomotive was so severe that the focus of the camera lenses was disturbed during the test run. As a result, the pictures are slightly out of focus on all three tests which never happened on any of the other locomotives tested. Owing to this fact it is difficult to determine the intermittent puffs of smoke usually expected and the observations in Table II involve some doubt.

No. 5623, with lightweight reciprocating parts, was slipped at 111 and 115 m.p.h. without rail damage. Normal riding characteristics were observed at these speeds in comparison with the poor qualities of No. 5604 to the extent that No. 5604 could not be used at such speeds in road service. It is interesting to note that two of these six locomotives tested. The mathematical basis for these curves is given in the appendix of this paper showing that the vibration of the locomotive is treated as a system having a single degree of freedom for the simple case where springs are interposed between two masses which operate on a second set of springs. One of these masses is the sprung weight such as the boiler, frame etc.; the second mass is the unsprung weight of the driver axle assembly. These two masses are separated by driving springs and this unit is supported on the track structure which is considered here as an elastic foundation functioning as springs. This system has certain critical frequencies and if the driving wheels rotate near such critical speeds then forced vibrations will be produced by the overbalance. It is realized that these ideal assumptions are not fully realized in the case of actual

Table V — Comparison of Actual with Calculated Speeds at Which Main Driver Leaves Rail

Locomotive Class	Locomotive Number	Reciprocating weight per side, lb.	Overbalance lb.	Train speed entering greased section	Speed at which main driver just leaves the rail, m.p.h. — Calculated values: Due to vibrations track modulus 1,500 lb. per in., per in.	Due to inertia effects of overbalance	Slip speeds at which locos. were tested and observations as to main wheel lift off rail	Rail damage requiring replacement
4-6-4	3012	2,109	315	56	86	99	98—Lifted slightly	None
				66			108—Lifted 7/8 in.	39 rails
4-6-4	3001	2,109	315	47			88—Intermittent puff smoke Believed just lifting	None
				67	86	100	98—Lifted slightly	None
				70			100—Lifted slightly	None
4-6-4	4003	1,026	103	72			112—Intermittent puff smoke Believed just lifting	None
				78	114	158	123—Lifted slightly	None
				81			128—Lifted 1/4 in.	None
4-8-4	5604	2,480	125	67			93*—No smoke or lift visible	None
				74	94	120	102—No smoke or lift visible	None
				80			*104—Smoke visible—Believe lifted slightly	None
4-8-4	5,623	1,378	115	78	...	...	111—Lifted slightly	None
				80	97	127	115—Lifted about 1/2 in.	None
2-10-4	6314	2,453	175	51	...	...	80—Lifted slightly	None
				53	79	96	80—Lifted slightly	None

* Camera lens focus changed during test run and pictures were slightly out of focus due to severe locomotive vibrations explained in text.

locomotives save approximately $503 per day in operating expense by doubling the North Coast Limited and the Empire Builder between Aurora, Ill. and St. Paul, Minn., a distance of 402 miles, when normal train heating conditions permit. This engine satisfactorily makes the schedule with trains as heavy as 23 passenger-train cars. It is an outstanding performance and illustrates in marked fashion the wide field of usefulness for heavy eight-coupled locomotives equipped with proper balance and light-weight reciprocating parts thus permitting their operation at passenger-train speeds.

2-10-4 Locomotive Tests

The 2-10-4 locomotive tested is a heavy freight engine designed originally for hauling coal over the Beardstown Division from Southern Illinois to the Chicago district. Two slip tests were made at 80 m.p.h. which showed the wheel lifting slightly.

The motion pictures show relatively smooth operation of this large locomotive at the slipping speed of 80 m.p.h. and illustrates the wide value of usefulness for this heavy type of locomotive when equipped with the speed-raising factors of lightweight parts in connection with stabilized lateral motion following the use of roller bearings.

Effect of Overbalance on Wheel Lifting

An anlysis was made of the influence of the various factors which would cause forced vibrations of the driving wheel on the rail. Such calculations may enable one to predict the critical wheel speed as well as to give a rational explanation of the test results. Figs. 3, 13, and 19, and Table V show curves made in this study for the locomotive operating conditions, but until further data are available this method of analysis presents some very interesting facts which will now be discussed.

The speed at which the main driving wheel should leave the rail for various modulii of track structure is shown in Fig. 3* for all three 4-6-4 locomotives tested. The lower full line curve shows the wheel for Nos. 3012 and 3001 having 315 lb. overbalance as lifting at 86 to 90 m.p.h. for a track modulus varying from 1,500 to 3,000 lb. per in. per in. If the track was considered very rigid so that no vibration phenomenon were present then the inertia effect of overbalance would cause the wheel to leave at 99 m.p.h. as indicated in Fig. 3. Similar comments may be made of the upper full line curve for No. 4003 where the wheel is shown leaving the rail at 114 to 128 m.p.h., while if the inertia force of the overbalance was considered as a criterion, then the wheel would not leave until 158 m.p.h. The upper dotted curve predicts the condition for zero overbalance which was not tested.

A comparison of these calculated speeds at which the wheel leaves the rail is shown in Table V with the observed values from test.

Several general deductions which may be observed from this study are:

(a) When the overbalance is large, such as 315 lb., then the stiffness of the track has very little influence on the speed at which the driving wheel leaves the rail.

(b) As the overbalance approaches zero the value of the stiffness of the track becomes more important but such high allowable speeds are not of immediate interest.

* Figs. 3 to 8 inclusive appear on page 88 of the March issue.

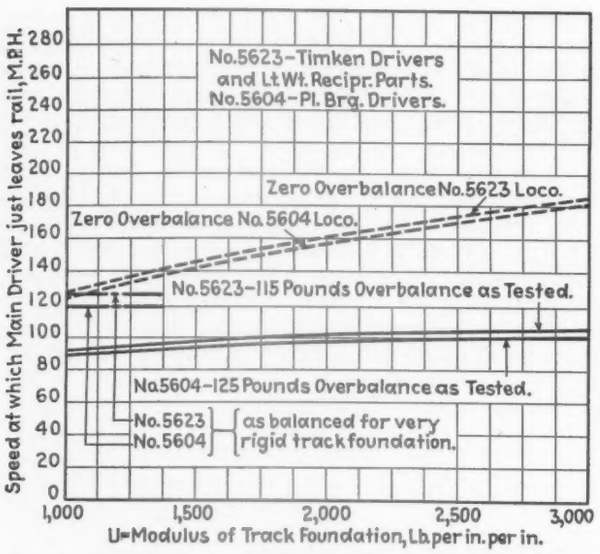

No.5623-Timken Drivers
and Lt.Wt. Recipr. Parts.
No.5604-Pl. Brg. Drivers.
Zero Overbalance No.5623 Loco.
Zero Overbalance No.5604 Loco.
No.5623-115 Pounds Overbalance as Tested.
No.5604-125 Pounds Overbalance as Tested.
No.5623
No.5604
as balanced for very
rigid track foundation.
Speed at which Main Driver just leaves rail, M.P.H.
U=Modulus of Track Foundation, Lb. per in. per in.

Fig. 13—Comparison of calculated speeds at which main drivers just leave rail—4-8-4 type locomotives

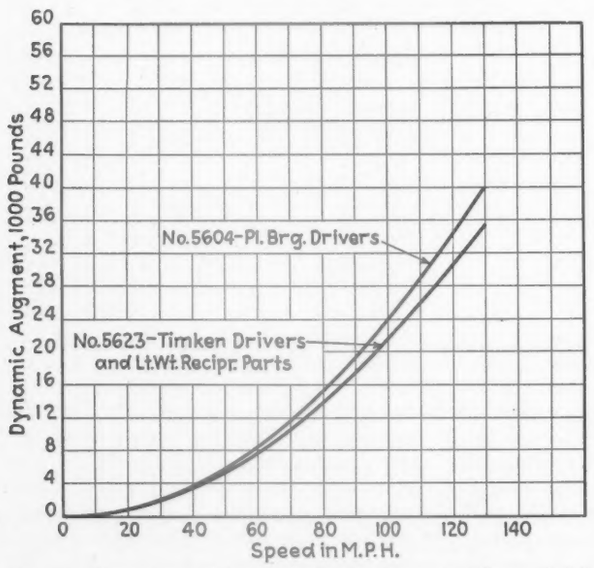


Fig. 14—Comparison of dynamic augment for main drivers—4-8-4 type locomotives

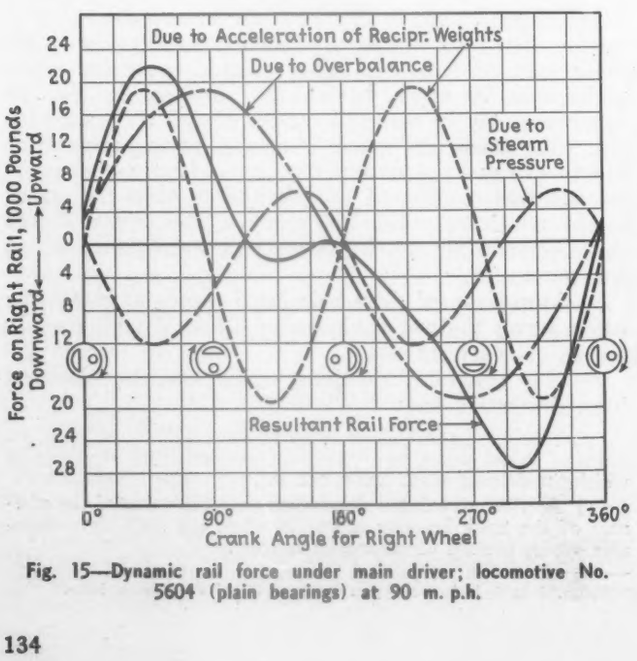


Fig. 15—Dynamic rail force under main driver; locomotive No. 5604 (plain bearings) at 90 m. p.h.

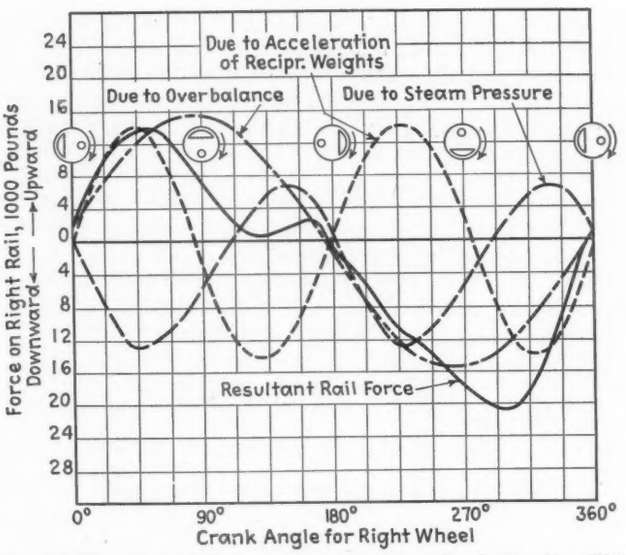


Fig. 16—Dynamic rail force under main driver; locomotive No. 5623 (Timken drivers and light weight reciprocating parts) at 90 m. p.h.

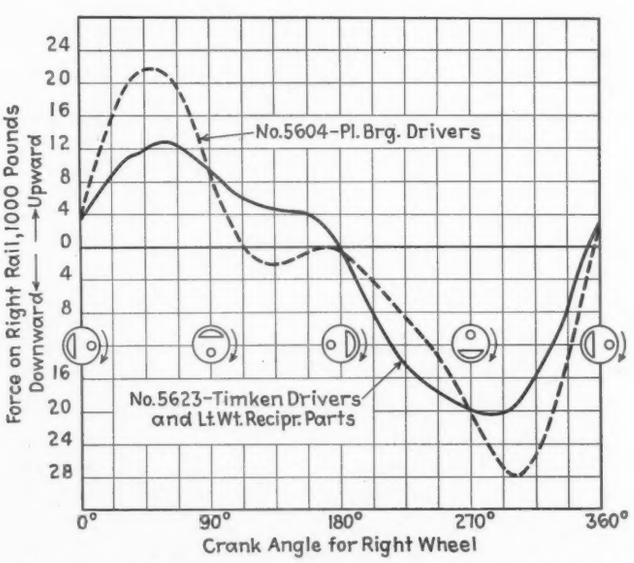

No.5604-Pl. Brg. Drivers
No.5623-Timken Drivers
and Lt.Wt. Recipr. Parts
Force on Right Rail, 1000 Pounds
Downward ← → Upward
Crank Angle for Right Wheel

Fig. 17—Comparison of resultant dynamic rail force for 4-8-4 type locomotives at 90 m. p.h.

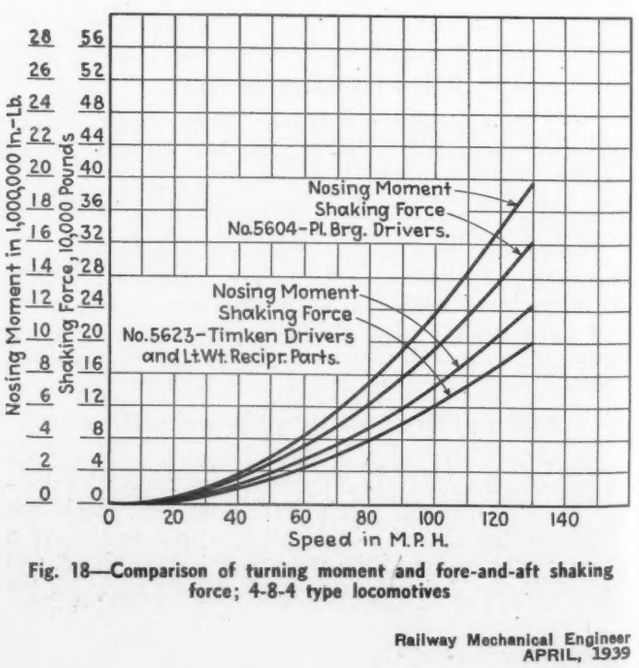


Fig. 18—Comparison of turning moment and fore-and-aft shaking force; 4-8-4 type locomotives

(c) Vibration phenomenon in many cases causes the wheel to lift off the rail within present locomotive operating conditions and at a speed much less than that required for the inertia force of the overbalance to be equal to the wheel load.

(d) Reduction of overbalance is a more important factor than increased track stiffness to permit higher operating speeds—this does not mean that heavier track is not desirable in order to reduce track stresses.

(e) A decrease of 1,000 lb. in the unsprung weight of the driving axle with 200 to 300 lb. overbalance would increase the speed at which the wheel leaves the rail by about 3 to 4 m.p.h.—this is not shown by these curves but may be determined using the calculations given in the appendix.

(f) More fundamental test data are necessary for the general application of vibration theory in practice, but indicated procedure gives results in good agreement with test values as shown in the table.

Main-Rod Error in Counterbalance Calculations

It is now customary in counterbalance calculations to consider the scale-pan weight of the back end of the main rod as rotating and the front-end weight as a portion of the total reciprocating weights. This procedure has existed for many years, although Henderson, in 1907, in his book, "Locomotive Operation," page 57, recognized that the proper division of back- and front-end weight requires a determination of the radius of gyration. He suggested that the radius of oscillation be found experimentally by swinging the rod as a pendulum. His practical conclusions for main-rod designs prevailing at that time were "one-half of the weight of the main rod is not far wrong for an approximation as to the balance needed to be added to the main wheel, considered as acting at the crank-pin radius."

This discrepancy between the existing procedure and the recommendations of Henderson introduces considerable error in the counterbalance statement of locomotives. Unfortunately, this error is in the wrong direction in that the overbalance in the counterbalance plane is actually higher than that given by the usual counterbalance statement. The actual error in the plane of counterbalance for the back end of the main rod and the corresponding increase in dynamic augment at diameter speed above the usually calculated value for the respective cross-counterbalanced engines is:

Locomotive	Main-rod error, lb.	Increased dynamic augment, lb.
3001-3012	107	4,800
4003	78	3,500
5604	131	5,100
5623	112	4,300

The above statements are based on pendulum tests of the main rods on the 4-6-4 and 4-8-4 locomotives used in these slipping tests. Here is was found that seven-eighths of the scale-pan weight of the back end of the plain-bearing main rod should be considered as rotating weight, and on roller-bearing rods a ratio of 0.82 was ascertained. For this reason, the counterbalance record in Table III gives the usual statement of balance along with the corrected values. These corrected values are the basis of all calculations in this paper unless specified, although, where reference is made to overbalance in either the text or in curves, the conventional overbalance value is stated.

Static balancing of the main driving axles is still being used on many locomotives, and the mechanical officers of some railroads are firm in their convictions that such a method has resulted in satisfactory operation of their locomotives. Some justification for their contentions may be attributed to the above-mentioned error in the distribution of main-rod weight. In the case where wheels are statically balanced, the compensation for this error tends to bring the static balance to an actual value which is somewhere between the static and cross-balanced wheels and may result in a favorable balance from the standpoint of dynamic augment and speed at which the wheels will leave the rail.

Vertical Rail Forces Under the Main Wheel

Dynamic augment due to overbalance is the usual variable force calculated as acting on the rail, but there are two additional rail forces which are present and sometimes of considerable importance, but very seldom, if ever, considered. These two forces are a function of the angularity of the main rod and produced by (a) piston-thrust values from the indicator card, and (b) the inertia of reciprocating parts. It is the combination of these two forces with that of the dynamic augment which are calculated here for the six locomotives tested and may be considered as the three principal factors constituting a resultant variable force on the rail. This resultant must be added to the static wheel load, plus any forces due to locomotive oscillation, vibration (impact factor), etc., and does not take care of additional forces due to irregular track, out-of-round wheels, etc., or the correction for wheel arrangement and spacing.

These calculated forces are shown for all three 4-6-4 locomotives in curves of Figs. 4, 5, 6, and 7. Maximum dynamic augment due to overbalance for various locomotive speeds is shown in Fig. 4, while Figs. 5 and 6 indicate how the three forces and their resultant varies during one revolution of the driving wheel. Fig. 7 compares the resultant rail forces shown in Figs. 5 and 6 for the cases of locomotives No. 3012 and 3001 having conventional weight of reciprocating parts and overbalance with No. 4003 which has light-weight reciprocating parts and low overbalance. The effect of the unbalanced reciprocating weight in producing shaking forces in the fore and aft directions as well as nosing or turning moment of the locomotive on the rails is shown in Fig. 17. In this the influence of tractive force at the wheels is neglected.

Similar studies are also shown for 4-8-4 locomotives in Figs. 14 to 18, inclusive and for 2-10-4 type in Figs. 20 to 24, inclusive.

Commenting on all these curves, it should be noted that as a result of about 50 per cent reduction in reciprocating weight and lower overbalance a much more favorable condition on track and locomotive is obtained as follows:

(a) Reduction of 60 per cent in dynamic augment is obtained on the 4-6-4 (Fig. 4) and 75 per cent on the 2-10-4 locomotives (Fig. 20).

(b) Even though the overbalance is decreased, the unbalanced forces producing shaking and nosing moment are at the same time decreased about 40 per cent for the 4-6-4 (Fig. 8) and about 25 per cent for the 2-10-4 locomotives (Fig. 24). Decreasing the overbalance in itself without reciprocating weight will increase the unbalanced disturbing forces shown in Figs. 8 and 24. There is a limit to which the unbalanced forces on conventional engines may be increased to give good riding qualities of a locomotive and minimum cost of track and locomotive maintenance, all of which are unknown factors from a standpoint of dollar value.

(c) Resultant variable rail force for 4-6-4 locomotives (Fig. 7) shows a favorable reduction of about 55 per cent in the downward, and 75 per cent in the upward directions to give a 65 per cent less overall change in variable rail force.

(d) Resultant variable rail force for the 2-10-4 locomotives (Fig. 23) shows a favorable overall reduction of about 68 per cent. This modified M-4-A was not tested, but is under construction, and it will be interesting to observe its service performance in view of its being underbalanced as calculated by conventional methods.

(e) With about the same overbalance on the two 4-8-4 locomotives the dynamic augment (Fig. 14) is about the same, but, due to the 44 per cent lower weight of reciprocating parts of No. 5623 compared with No. 5604, the resultant rail force (Fig. 17) is about 25 per cent less in the downward, and 40 per cent less in the upward, direction to give about 30 per cent less overall change in variable rail force.

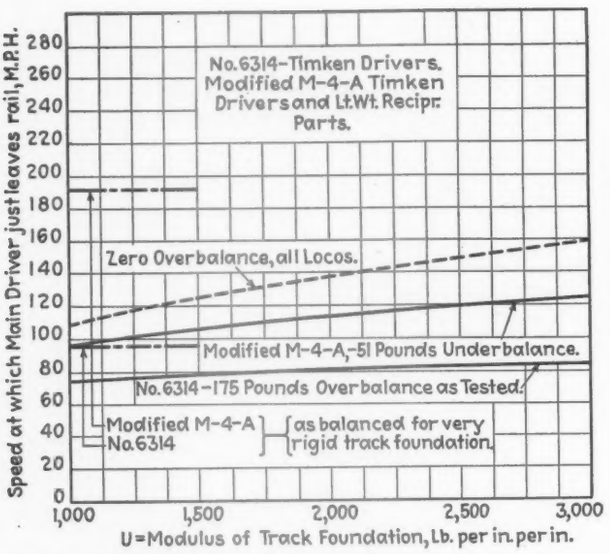

No. 6314-Timken Drivers. Modified M-4-A Timken Drivers and Lt. Wt. Recipr. Parts.
Zero Overbalance, all Locos.
Modified M-4-A, -51 Pounds Underbalance.
No. 6314 - 175 Pounds Overbalance as Tested.
Modified M-4-A No. 6314
as balanced for very rigid track foundation.
Speed at which Main Driver just leaves rail, M.P.H.
U = Modulus of Track Foundation, Lb. per in. per in.

Fig. 19—Comparison of calculated speeds at which main drivers just leave the rail; 2-10-4 type locomotives

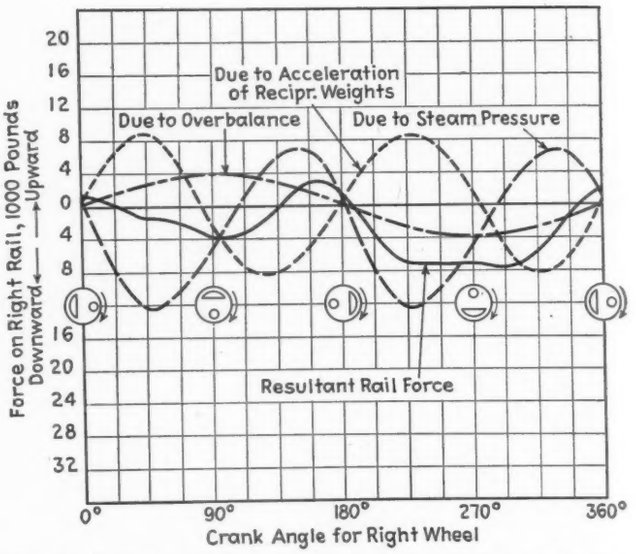

Due to Acceleration of Recipr. Weights
Due to Overbalance
Due to Steam Pressure
Resultant Rail Force
Force on Right Rail, 1000 Pounds Downward ← → Upward
Crank Angle for Right Wheel

Fig. 22—Dynamic rail force under main driver; modified class M-4-a, 2-10-4 type locomotive equipped with Timken driver bearings and light-weight reciprocating parts

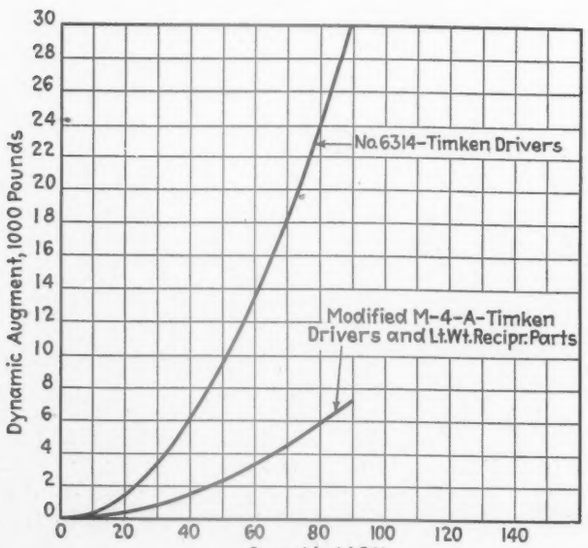


Fig. 20—Comparison of dynamic augment for main drivers; 2-10-4 type locomotives

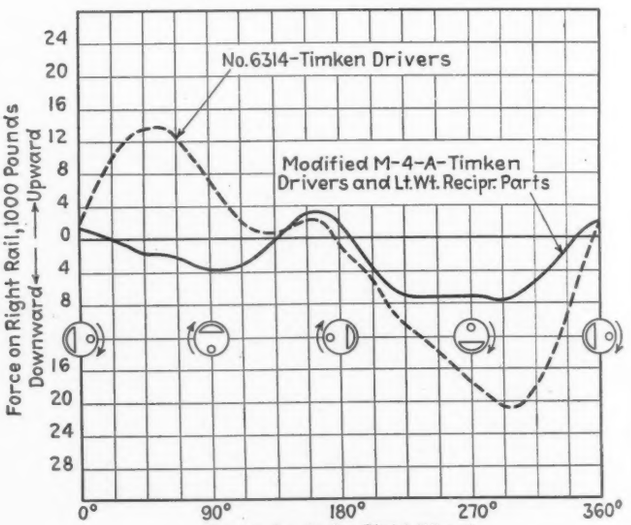

No. 6314-Timken Drivers
Modified M-4-A-Timken Drivers and Lt. Wt. Recipr. Parts
Force on Right Rail, 1000 Pounds Downward ← → Upward
Crank Angle for Right Wheel

Fig. 23—Comparison of resultant dynamic rail force for 2-10-4 type locomotives at 64 m. p.h.

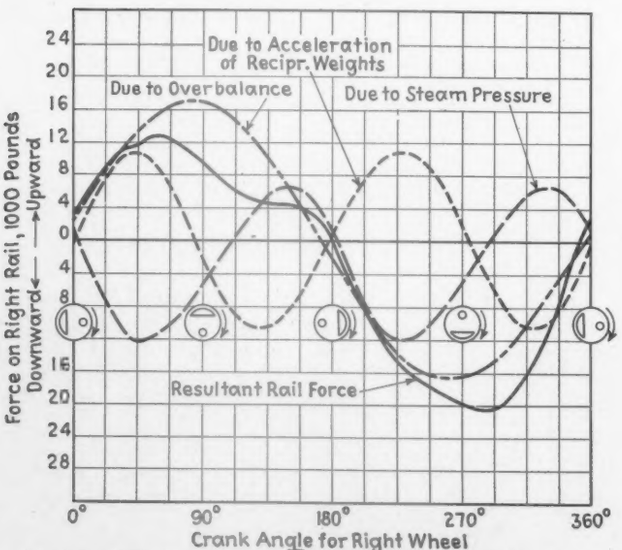

Due to Acceleration of Recipr. Weights
Due to Overbalance
Due to Steam Pressure
Resultant Rail Force
Force on Right Rail, 1000 Pounds Downward ← → Upward
Crank Angle for Right Wheel

Fig. 21—Dynamic rail force under main driver; 2-10-4 type locomotive No. 6314, equipped with Timken driver bearings

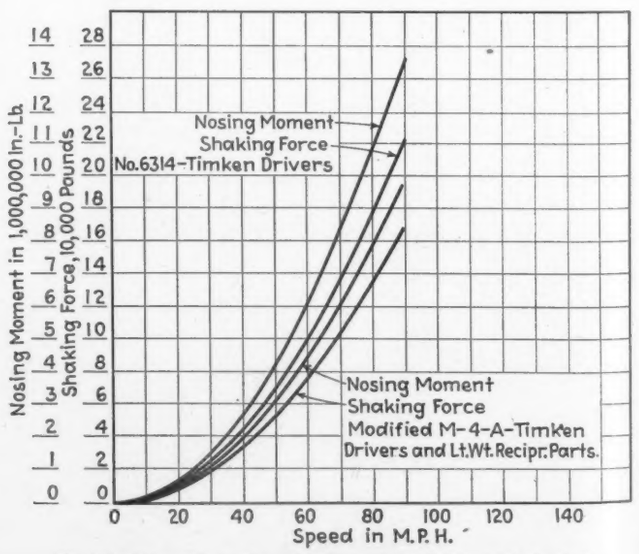


Fig. 24—Comparison of turning moment and fore-and-aft shaking force; 2-10-4 type locomotives

(f) Of the two 4-8-4 locomotives having about the same overbalance, No. 5623, with 44 per cent lower reciprocating weight than No. 5604, gives about 35 per cent less disturbing force (Fig. 18) and should be a much better riding engine as was found on the test.

(g) The frequency of the rail force components due both to piston thrust and inertia of reciprocating parts is twice that of the dynamic augment, as indicated in Figs. 5, 6, 15, 16, 21, and 22. For this reason their effect (neglecting that they do not vary according to a sine law) in causing vibrations at the test speeds is of much less importance than the dynamic augment.

(h) Large variations in wheel pressure and the large magnitude of the shaking forces and nosing moments given in all these curves may be suggested as being partially responsible for intermittent slipping of drivers to the extent that it affects the frictional coefficient between the wheel and rail.

It is appreciated that the above analysis is based on calculations, although only fundamental principles of mechanics are applied. The procedure used requires much additional study in correlation with further locomotive and track tests.

Permissible Locomotive Operating Speeds

Following these tests it was necessary to establish maximum safe operating road speeds from the standpoint of rail damage for locomotives of the classes tested. Such speed was determined from a study of: (a) The slipping test speed at which the main driving wheels started to leave the rail; (b) speed for which the dynamic augment was equal to 50 per cent of the static wheel load, and (c) speed at which the calculated rail stress would be about 30,000 lb. per sq. in. It was considered that a compromise maximum speed for locomotive operation could be selected from these three criteria which would not cause rail damage. On this basis, the maximum road speeds were specified as in Table VI which indicates the increase in allowable speed permitted on those locomotives equipped with light-weight reciprocating parts over those having conventional weights. In order to make train schedules, however, it is necessary to exceed the speed values given in Table VI by about 5 m.p.h.

Table VI — Permissible Maximum Locomotive Road Speeds

Locomotives	Weight, lb. Reciprocating parts	Weight, lb. Overbalance main wheel	Max. road speed, m.p.h.
4-6-4 (like nos. 3012 and 3001) ..	2,109	315	75
4-6-4 (like No. 4003)	1,026	103	No limit
4-8-4 (like No. 5604 but with conventional overbalance)	2,480	310	75
4-8-4 (like No. 5623)	1,378	115	No limit
2-10-4 (like No. 6314)	2,453	175	60

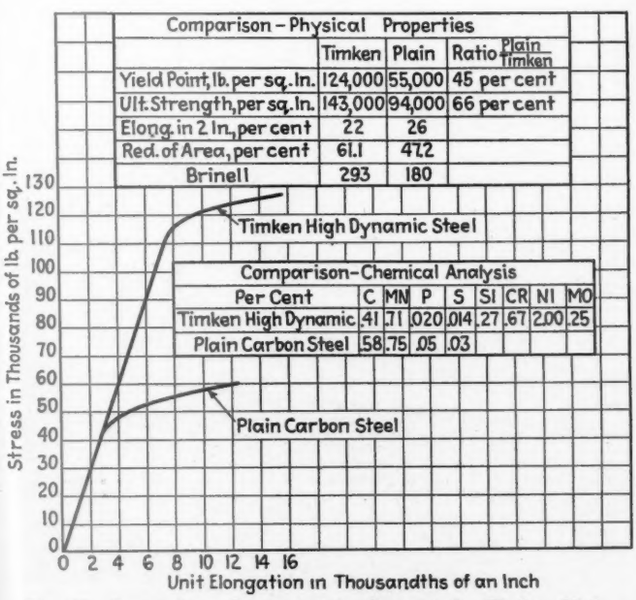

Comparison – Physical Properties
Timken
Plain
Ratio Plain/Timken
Yield Point, lb. per sq. in. 124,000 55,000 45 per cent
Ult. Strength, per sq. in. 143,000 94,000 66 per cent
Elong. in 2 in., per cent 22 26
Red. of Area, per cent 61.1 47.2
Brinell 293 180
Timken High Dynamic Steel
Comparison–Chemical Analysis
Per Cent C MN P S SI CR NI MO
Timken High Dynamic .41 .71 .020 .014 .27 .67 2.00 .25
Plain Carbon Steel .58 .75 .05 .03
Plain Carbon Steel
Stress in Thousands of lb. per sq. in.
0 10 20 30 40 50 60 70 80 90 100 110 120 130
0 2 4 6 8 10 12 14 16
Unit Elongation in Thousandths of an Inch

Fig. 25—Comparison of stress-strain diagrams for Timken High-Dynamic and plain carbon steels

Method of Obtaining Light Reciprocating and Rotating Weights

The material used in these parts has the trade name of Timken high dynamic steel and the chemical analysis and physical properties are given in Fig. 25 in comparison with plain carbon steel commonly used. All parts are steel, except for the use of an aluminum crosshead shoe, and detail weights of the respective parts are shown in Table II in comparison with parts of conventional design and material.

All parts are heat treated and are either die forged, rolled, or steel tubing, with the exception of crank pins which are hammer forgings. Particular emphasis is placed on proper grain flow for maximum strength. In addition to using a material having over twice the static strength of the usual steel used for this purpose, important consideration is given to the shape of the various design members so as to give the proper distribution of metal for maximum strength with minimum weight.

Further data on this subject are published in the Transactions of the American Society of Mechanical Engineers, April, 1937, page 225*.

Future Locomotive Design

General conclusions from this paper indicate that many new problems are associated with high-speed locomotives. It is believed that the application of light-weight parts both to the reciprocating and rotating parts will be an essential modification required on high-speed steam locomotives for satisfactory operation of not only the locomotive, but also the effect such operation will have on existing and even greatly improved track and bridge structures.

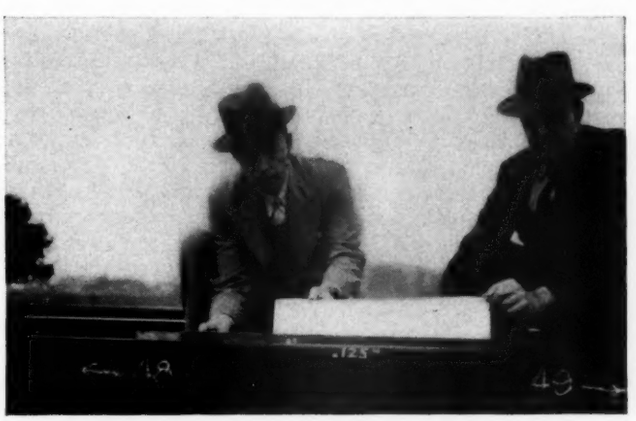


Fig. 26—A rail kink ⅛ in. deep produced by locomotive No. 3012 at 108 m. p. h. slipping speed

While it is not difficult to obtain agreement that such weight reductions are desirable, there may be some questions as to whether satisfactory designs are available, and operating performance records indicate the advisability of making such departures from conventional practice. The answer to these questions may be found from the record of 64 locomotives which are in operation over several railroads in the heaviest and fastest passenger and freight service where the total accumulated service is 9,000,000 miles. All of these locomotives have light-weight reciprocating parts and 14 have, in addition, light-weight rods and roller-bearing crank pins. These 14 en-

* For an abstract of this paper see *Railway Mechanical Engineer*, August, 1937, page 348.

gines have a total accumulated service of 1,700,000 miles. New applications being built or just placed in service also total 14 locomotives.

The usual price of pioneering has been experienced in this field of lightweight parts in that failures have occurred. This development generally has been extremely encouraging, and in this respect much credit is due those railroads which have contributed toward its success.

Appendix

Formula for Determining the Speed At Which Driving Wheels Just Lift Off the Rail Due to Vibrations

The equation used to calculate the minimum locomotive speed, in miles per hour, at which a driving wheel of a steam locomotive lifts off the rail due to vibrations caused by overbalance (or underbalance) is:

$$\text{M.p.h.} = \frac{\omega D}{35.2} = \frac{D}{35.2}\sqrt{\frac{(K + K_{rail})\,g}{W + \left(\frac{K_{rail}}{S + W}\right) RW_{over}}}$$

Where:

m.p.h. = lowest speed at which wheel leaves rail, m.p.h.
ω = angular velocity of driving wheel, radians per second
D = diameter of driving wheels, in.
g = acceleration of gravity = 384 in. per second per second
R = Crank radius, in.
K = spring stiffness of spring between driving-axle housing and frame per side, lb. per in.
K_{rail} = Rail stiffness = force required to depress rail a distance of one inch, lb. per in.
S = Sprung weight per driver, lb.
W_{over} = overbalance at crank radius per driver, lb.
W = unsprung weight per driver, lb.

The derivation of the above equation is given below. In this derivation, vibrations of the body of the locomotive, the effects of friction, the effects of inertia forces on the reciprocating parts combined with angularity of the main rod, the effects of piston thrust due to steam pressure combined with angularity of the main rod, the effect of rail deflection due to one driver on vibrations of the other drivers, the effect of the mass of the rail, the effect of the spring equalizer system, and other effects are neglected. It is believed that all these effects are secondary compared to the effect of overbalance when the overbalance is considered as is the case on most steam locomotives.

With the above simplifications, the disturbing force on a driving wheel tending to set up vertical vibrations of the driver on the rail is:

$$F = \frac{W_{over}}{g}\omega^2 R\cos\omega t$$

this being the upward component of the centrifugal force on the equivalent overbalance in the wheel at crank radius, with

t = time in seconds which has elapsed since the crank was at its extreme downward position (the overbalance is assumed to be directly opposite the crank).

The upward displacement of the driving wheel from its normal position due to the above disturbing force will be (Vibration Problems in Engineering, by S. Timoshenko, page 9, equation 19):

$$X = \frac{F}{(K + K_{rail})} \times \frac{1}{\left(1 - \frac{\omega^2}{P^2}\right)} = \frac{RW_{over}}{W} \times \frac{\omega^2}{P^2 - \omega^2}\cos\omega t$$

Where

$$P^2 = \frac{(K + K_{rail})\,g}{W}$$

and the maximum value of X will be

$$X_{max} = \frac{RW_{over}}{W} \times \frac{\omega^2}{P^2 - 2}$$

If the wheel is on the point of leaving the rail, then

$$X_{max} = \frac{S + \omega}{K_{rail}}$$

this being the deflection of the rail due to the static wheel load. Then the minimum speed at which the wheel will leave the rail is obtained by solving the equation:

$$\frac{S + W}{K_{rail}} = \frac{RW_{over}}{W} \times \frac{\omega^2}{P^2 - \omega^2}$$

which gives

$$\omega = \frac{P}{\sqrt{1 + \left(\frac{K_{rail}}{S + W}\right)\frac{W_{over}}{W}R}} = \sqrt{\frac{(K - K_{rail})\,g}{W + \left(\frac{K_{rail}}{S + W}\right) RW_{over}}}$$

and since

$$\text{M.p.h.} = \frac{\omega D}{35.2}$$

we get

$$\text{M.p.h.} = \frac{D}{35.2}\sqrt{\frac{(K + K_{rail})\,g}{W + \left(\frac{K_{rail}}{S + W}\right) RW_{over}}}$$

Fig. 27—Worn spot on right rail at tie marker No. 55; produced by locomotive No. 3012 at 108 m. p. h. slipping speed

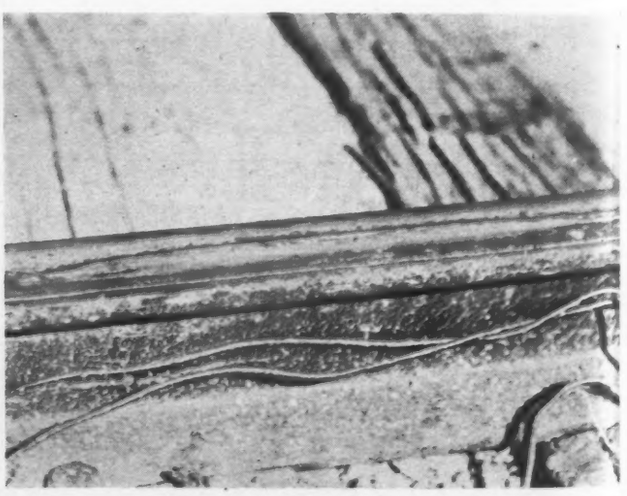


Fig. 28—Worn spot on rail three feet before tie marker No. 50; also produced by locomotive No. 3012 at slipping speed of 108 m. p. h.

Passenger Cars Air-Conditioned During 1938

Passenger Cars Air-Conditioned During 1938

Railroad	No. of Cars	Type of Cars	Type of System	Manufacturer	Compressor Drive	Refrigerant	Generators: No.	Generators: Capacity Kw.	Generators: Type of Drive	Generators: Type of Mounting	Storage Batteries: Make	Storage Batteries: Amp.-Hr. Capacity	Outside Power Supply
A. T. & S. F.	32	Chair	St. ejec.	Safety C. H. & L.	.....	Water	1	10	Flat belt	Body	Exide	850	....
	12	Diners	St. ejec.	Safety C. H. & L.	.....	Water	2	(1-2) (1-4)	Flat belt	Truck	Exide	850	....
							10	10	Flat belt	Body	Exide	850	....
A. C. L.	25	Coaches	St. ejec.	Safety C. H. & L.	.....	Water	1	10	Flat belt	Body	(19 Exide / 6 Edison)	850	....
Can. National	65	Coaches	Ice	Sturtevant	.....	Ice	1	4	(Flat belt in summer—chain in winter)	Truck	Exide, Edison or Gould	600	....
	20	Diners	Ice	Sturtevant	.....	Ice	8 / 12	5 / 4	Flat belt or chain	Truck	Exide and Gould	600	....
	2	Chair	Ice	Sturtevant	.....	Ice	1	5	Flat belt	Body	Gould	600	....
	57	Sleepers	Ice	Sturtevant	.....	Ice	1	4	Flat belt	Truck	Exide and Gould	600	....
Can. Pacific	42	Coaches	Ice	Sturtevant	.....	Ice	19 / 23	5 / 3	Gear	Body	3 Exide	600	....
											2 Gould	600	....
											23 Edison	300	....
											14 Edison	595	....
	16	Diners	Ice	Sturtevant	.....	Ice	1	3	Belt	Body	12 Edison	595	....
											4 Gould	600	....
	2	Buffet-lounge	Ice	Sturtevant	.....	Ice	1	5	Gear	Body	Exide	600	....
	1	Cafe-chair	Ice	Sturtevant	.....	Ice	1	3	Gear	Body	Gould	600	....
	4	Buffet-chair	Ice	Safety C. H. & L.	.....	Ice	1	3	Gear	Body	Edison	595	....
	17	Sleepers	Ice	Safety C. H. & L.	.....	Ice	1	3	Belt	Body	Edison	595	....
	2	Sleepers	Ice	Sturtevant	.....	Ice	1	5	Gear	Body	Exide	600	....
	1	Sleeper	Ice	Airtemp	.....	Ice	1	5	Gear	Body	Exide	600	....
	4	Sleepers	Ice	Safety C. H. & L.	.....	Ice	1	5	Gear	Body	Exide	600	....
	1	Lounge	Ice	Safety C. H. & L.	.....	Ice	1	7½	Gear	Body	Gould	600	....
Central of Georgia	8	Coaches	St. ejec.	Safety C. H. & L.	.....	Water	1	10	Flat belt	Body	(10 Edison / 1 Exide)	850	....
	3	Comb.	St. ejec.	Safety C. H. & L.	.....	Water	1	10	Flat belt	Body		680	....
C. & E. I.	2	Comb.	St. ejec.	Safety C. H. & L.	.....	Water	1	2½	Flat belt	Body	Gould	850	....
	1	Coach	St. ejec.	Safety C. H. & L.	.....	Water	1	10	V-belt-gear	Body	Philco	940	....
C. M. St. P. & P.	4	Comb.	St. ejec.	Safety C. H. & L.	.....	Water	1	10	V-belt	Truck	Gould	850	....
	24	Coaches	St. ejec.	Safety C. H. & L.	.....	Water	1	10	V-belt	Truck	7 Gould	850	....
											17 Exide	823	....
	5	Coaches	Mech.	Waukesha	Gas engine	Freon	1	5	V-belt	Truck	Gould	450	....
	4	Diners	St. ejec.	Safety C. H. & L.	.....	Water	1	10	V-belt	Truck	Gould	850	....
	10	Chair	St. ejec.	Safety C. H. & L.	.....	Water	1	10	V-belt	Truck	Exide	823	....
	2	Cafe-chair	Mech.	Waukesha	Gas engine	Freon	1	5	V-belt	Truck	Exide and Gould	450	....
C. R. I. & P.	10	Coaches	Mech.	Waukesha	Gas engine	Freon	1	4	Flat belt	Body	.....	400	....
	1	Diner	Mech.	Waukesha	Gas engine	Freon	1	4	Flat belt	Body	.....	400	....
	1	Business	Ice	A. C. F.	.....	Ice	1	4	Flat belt	Body	.....	400	....
D. L. & W.	1	Business	Ice	Safety C. H. & L.	.....	Ice	2	4	V-belt	Body	Edison	850	....
	1	Business	Ice	Safety C. H. & L.	.....	Ice	1	5	V-belt	Body	Gould	600	....
Great Northern	6	Coaches	Ice	P. S. C. M. C.	.....	Ice	1	4	(4 Flat belt / 2 V-belt)	Body	Exide	600	....
	1	Coach	Ice	R. R. Co.	.....	Ice	1	4	V-belt	Body	Exide	500	....
	2	Cafe-chair	Ice	R. R. Co.	.....	Ice	1	4	V-belt	Body	Exide	500	....
	1	Business	Ice	R. R. Co.	.....	Ice	1	7½	V-belt	Body	Exide	888	....
Lehigh Valley	1	Lounge diner	Electro-mech.	General Electric Co.	Motor	Freon	1	20	V-belt-gear	Body	Exide	1,000	....
M. St. P. & S. Ste. M.	2	Cafe-sleepers	Ice	P. S. C. M. C.	.....	Ice	1	3	Flat belt	Body	Gould	600	....
M.-K.-T.	20	Chair	St. ejec.	Safety C. H. & L.	.....	Water	1	10	V-belt-gear	Body	(10 Gould / 10 USL)	1,000	....
Mobile & Ohio	2	Lounge-diners	Mech.	Wuakesha-Trane	Gas engine	Freon	1	5	Flat belt	Body	Exide	450	....
N. Y. C. System	2	Coaches	Electro-mech.	Frigidaire	Motor	Freon	1	20	Gear	Body	Exide	600 at 64 v.	*
	6	Diners	Electro-mech.	Frigidaire	Motor	Freon	1	20	Gear	Truck	Exide		*
N. Y. N. H. & H.	50	Coaches	Electro-mech.	Frigidaire-Safety C. H. & L.	Motor	Freon	1	20	Gear	Body	Exide	500	*
Norfolk & Western	5	Coaches	Electro-mech.	Frigidaire	Motor	Freon	1	20	Gear	Body	Edison	300 at 110 v.	*
Northern Pacific	4	Coaches	Mech.	P. S. C. M. C.	Speed reducer	Freon	1	4	V-belt	Body	Gould	600	*
	5	Coaches	Mech.	Waukesha-Trane	Gas engine	Freon	1	5	V-belt	Body	Exide	600	....
	2	Cafe	Mech.	P. S. C. M. C.	Speed reducer	Freon	1	4	V-belt	Body	Gould	600	*
	1	Chair	Mech.	Waukesha-Trane	Gas engine	Freon	1	4	V-belt	Body	Exide	600	....
Pennsylvania	2	Coaches	Mech	Airtemp	Gear	Freon	1	10	Gear	Body	.....	1,250	....
	2	Diners	Electro-mech.	Frigidaire	Motor	Freon	1	20	Gear	Body	.....	1,250	....
	1	Diner	Electro-mech.	Frigidaire	Motor	Freon	1	7.6	V belt	Body	.....	1,000	....

*Cars marked thus are equipped for 220-volt a.c. operation at terminals

Passenger Cars Air-Conditioned During 1938 (Continued)

Railroad	No. of Cars	Type of Cars	Type of System	Manufacturer	Compressor Drive	Refrigerant	Generator				Storage Batteries		Outside Power Supply
							No.	Capacity Kw.	Type of Drive	Type of Mounting	Make	Amp.-Hr. Capacity	
Pullman Co.	45	Sleepers	Mech.	P. S. C. M. C.	Speed reducer	Freon	1	4	Flat belt	Body	Exide	550	*
	1	Sleeper	Mech.	P. S. C. M. C.	Speed reducer	Freon	1	7½	V-belt-gear	Body	Exide	550	*
	1	Sleeper	Electro-mech.	P. S. C. M. C.	Motor	Freon	1 1	15 4	V-belt-gear Flat belt	Body	Exide	1,000	*
	4	Sleeper	Ice	Pullman	.....	Ice	1	4	Flat belt	Body	Exide	600	....
	8	Chair	Mech.	P. S. C. M. C.	Speed reducer	Freon	1	4	Flat belt	Body	Exide	550	*
	60	Sleepers	Mech.	P. S. C. M. C.	Speed reducer	Freon	1	5	V-belt	Body	Exide	620	*
	37	Sleepers	Mech.	P. S. C. M. C.	Speed reducer	Freon	1	7½	V-belt-gear	Body	Exide	875	*
	11	Sleeper-obs.	Mech.	P. S. C. M. C.	Speed reducer	Freon	1	10	V-belt-gear	Body	Exide	875	*
	15	Sleeper-lounge	Mech.	P. S. C. M. C.	Speed reducer	Freon	1	10	V-belt-gear	Body	Exide	875	*
	27	Sleepers	St. ejec.	Safety C. H. & L.	.....	Water	2	5	V-belt	Body	Exide	875	....
	7	Sleeper-obs.	St. ejec.	Safety C. H. & L.	.....	Water	2	5	V-belt	Body	Exide	875	....
St. L.-S. F	2	Coaches	Mech.	Waukesha	Gas engine	Freon	1	4	Flat belt	Body	Exide	504	....
	6	Comb.	Mech.	Waukesha	Gas engine	Freon	1	4	Flat belt	Body	Exide	504	....
	4	Chair	Mech.	Waukesha	Gas engine	Freon	1	4	2 Flat belt 2 V-belt	Body	Exide	504	....
Seaboard A. L.	4	Coaches	Mech.	P. S. C. M. C.	Speed reducer	Freon	1	4	Flat belt	Body	Edison	300	....
Southern	79	Coaches	St. ejec.	Safety C. H. & L.	.....	Water	1	10	Flat belt	Body	Exide	600	....
	27	Comb.	St. ejec.	Safety C. H. & L.	.....	Water	1	10	Flat belt	Body	Exide	600	....
Un. Pac.	2	Lounge-diners	Mech.	Waukesha	Gas engine	Freon	1	5	Flat belt	Body	Exide	500	....
	1	Business	Mech.	Waukesha	Gas engine	Freon	1	5	Flat belt	Body	Exide	1,000	....

Summary of Cars Air-Conditioned During 1938

Railroad	Number of Cars	Type of Car							Type of System				Refrigerant Used		
		Coach	Combination	Dining (Note A)	Chair (Note B)	Observation	Sleeping (Note C)	Business	Electro-Mech.	Direct Mech.	Ice	Steam Ejector	Freon	Water	Ice
A. T. & S. F.	44	...	...	12	32	...	...	...	...	...	...	44	...	44	...
A. C. L.	25	25	...	...	...	...	...	...	...	...	...	25	...	25	...
Can. National	144	65	...	20	2	...	57	...	...	...	144	...	...	...	144
Can. Pacific	90	42	...	23	1	...	24	...	...	...	90	...	...	...	90
Central of Georgia	11	8	3	...	...	...	...	...	...	...	...	11	...	11	...
C. & E. I.	3	1	2	...	...	...	...	...	...	...	...	3	...	3	...
C. M. St. P. & P.	49	29	4	6	10	...	...	...	...	7	...	42	7	42	...
C. R. I. & P.	12	10	...	1	...	...	...	1	...	11	1	...	11	...	1
D. L. & W.	2	...	...	...	...	...	...	2	...	...	2	...	...	...	2
Great Northern	10	7	...	2	...	...	...	1	...	...	10	...	...	...	10
Lehigh Valley	1	...	...	1	...	...	...	...	1	...	...	...	1	...	...
M. St. P. & S. Ste. M.	2	...	...	...	...	...	2	...	...	...	2	...	...	...	2
M-K.-T.	20	...	...	...	20	...	...	...	...	...	...	20	...	20	...
Mobile & Ohio	2	...	...	2	...	...	...	...	...	2	...	...	2	...	...
N. Y. C. System	8	2	...	6	...	...	...	...	8	...	...	...	8	...	...
N. Y. N. H. & H.	50	50	...	...	...	...	...	...	50	...	...	...	50	...	...
Norfolk & Western	5	5	...	...	...	...	...	...	5	...	...	...	5	...	...
Northern Pacific	12	9	...	2	1	...	...	...	...	12	...	...	12	...	...
Pennsylvania	5	2	...	3	...	...	...	...	3	2	...	...	5	...	...
Pullman Co.	216	...	...	...	8	...	208	...	1	177	4	34	178	34	4
St. L.-S. F.	12	2	6	...	4	...	...	...	...	12	...	...	12	...	...
Seaboard A. L.	4	4	...	...	...	...	...	...	...	4	...	...	4	...	...
Southern	106	79	27	...	...	...	...	...	...	...	...	106	...	106	...
Union Pacific	3	...	...	2	...	...	...	1	...	3	...	...	3	...	...
	836	340	42	80	78	...	291	5	68	230	253	285	298	285	253

Note A—Includes lounge-diners, coach-diners, cafe chair, cafe coach, kitchen coach and buffet cars.
Note B—Includes lounge-chair, coach-chair and observation-chair cars.
Note C—Includes lounge- and observation-sleepers.

Nine-Year Summary of Air-Conditioned Cars

Note A—Includes lounge-diners, coach-diners, cafe chair, cafe coach, kitchen coach and buffet cars.
Note B—Includes lounge-chair, coach-chair and observation-chair cars.
Note C—Includes lounge- and observation-sleepers.

Nine-Year Summary of Air-Conditioned Cars

Railroad	Total Cars		Type of Car							Type of System				Type of Refrigerant		
	Dec. 31, 1937	Dec. 31, 1938	Coaches	Comb.	Dining (Note 1)	Chair (Note 2)	Observation	Sleeping (Note 3)	Business	Electro-Mech.	Direct Mech.	Ice	Steam Ejector	Freon	Water	Ice
Alton	25	25	4	4	9	6	2	...	...	25	...	...	...	25	...	...
A. T. & S. F.	262	306	26	6	77	174	18	5	...	1	...	...	305	1	305	...
A. C. L.	109	134	106	...	28	...	...	...	...	11	...	...	123	11	123	...
B. & O.	372	372	225	55	75	6	10	...	1	372	...	...	...	372	...	...
B. & M.	90	90	82	4	4	...	...	...	...	30	...	60	...	30	...	60
Can. National	253	397	125	...	76	18	...	178	...	...	...	397	...	...	...	397
Can. Pacific	305	395	50	4	79	15	6	236	5	...	...	395	...	...	...	395
Central of Georgia	44	55	46	6	2	...	...	...	1	...	...	1	54	...	54	1
C. R. R. of N. J	23	23	17	2	4	...	...	...	...	23	...	...	...	23	...	...
C. & O. (Incl. P. M.)	113	113	79	14	12	...	...	...	8	...	104	...	9	104	9	...
C. & E. I.	31	34	22	5	7	...	...	...	...	...	2	5	27	2	27	5
C. & N. W.	196	196	115	16	37	28	...	...	...	12	110	74	...	122	...	74
C. B. & Q.	151	151	84	8	36	4	5	14	...	113	4	34	...	117	...	34
C. M. St. P. & P.	247	296	142	9	55	27	4	57	2	...	21	275	...	21	275	...
C. R. I. & P.	150	162	69	4	38	46	4	...	1	18	26	106	12	44	12	106
D. & H.	6	6	...	...	6	...	...	...	...	...	...	6	...	...	...	6
D. L. & W.	54	56	40	...	12	...	1	...	3	17	23	16	...	40	...	16
D. & R. G. W.	49	49	28	...	12	...	7	...	2	...	...	49	...	...	...	49
Erie	40	40	30	...	7	...	...	...	3	1	...	...	39	1	39	...
Fla. East Coast	32	32	22	...	10	...	...	...	...	...	...	...	32	...	32	...
Great Northern	63	73	42	...	28	...	...	...	3	...	12	61	...	12	...	61
G. M. & N.	12	12	5	...	2	...	...	4	1	7	5	...	...	12	...	...
Illinois Central	160	160	99	10	35	10	2	...	4	12	135	13	...	147	...	13
Lehigh Valley	15	16	4	...	8	4	...	...	...	16	...	...	...	16	...	...
L. & N.	135	135	119	...	16	...	...	...	...	...	...	...	135	...	135	...
Maine Central	17	17	15	2	...	...	...	...	...	...	...	17	...	...	...	17
M. St. P. & S. Ste. M.	9	11	...	...	3	...	4	4	...	7	...	4	...	7	...	4
M.-K.-T.	26	46	...	...	12	28	5	...	1	6	...	3	37	6	37	3
Mo. Pac.	273	273	101	31	58	63	11	...	9	26	1	206	40	27	40	206
Mobile & Ohio	...	2	...	...	2	...	...	...	...	...	2	...	...	2	...	...
N. C. & St. L.	31	31	25	...	6	...	...	...	...	...	...	...	31	...	31	...
N. Y. C. System	312	320	183	1	132	2	1	...	1	247	58	15	...	305	...	15
N. Y. C. & St. L.	21	21	15	...	4	...	...	...	2	...	21	...	...	21	...	...
N. Y., N. H. & H.	387	437	379	17	35	6	...	...	...	304	...	133	...	304	...	133
Norfolk & Western	120	125	89	19	11	...	...	...	6	115	...	6	4	115	4	6
Northern Pacific	83	95	46	...	30	3	14	2	...	...	95	...	...	95	...	...
Pennsylvania	605	610	338	105	167	...	...	...	...	188	2	419	1	190	1	419
Pullman Co.	4,839	5,055	...	...	9	399	494	4,153	...	188	3,097	1,356	414	3,285	414	1,356
Reading	63	63	41	11	9	...	2	...	...	63	...	...	...	63	...	...
R. F. & P.	25	25	14	2	8	...	...	...	1	13	9	1	2	22	2	1
St. L.-S. F.	102	114	46	10	28	21	2	2	5	1	22	91	...	23	...	91
Seaboard A. L.	95	99	51	17	27	...	...	...	4	4	95	...	...	99	...	...
Southern	36	142	81	27	34	...	...	...	...	...	...	...	142	...	142	...
Southern Pacific	399	399	169	2	103	113	4	...	8	...	100	225	74	100	74	225
Texas & Pacific	61	61	39	...	12	4	4	...	2	1	9	21	30	10	30	21
Union Pacific	318	321	63	...	85	129	37	5	2	26	231	...	64	257	64	...
Wabash	66	66	18	...	18	27	...	...	3	...	...	66	...	...	...	66
Western Pacific	15	15	7	...	5	...	3	...	...	3	...	...	12	3	12	...
Total	10,840	11,676	3,301	391	1,473	1,133	640	4,660	78	1,850	4,184[4]	4,055	1,587	6,034	1,862	3,780

Note 1—Includes lounge-diners, coach-diners, cafe-chair, cafe-coach, kitchen-coach and buffet cars.
Note 2—Includes lounge-chair, coach-chair and observation-chair cars.
Note 3—Includes lounge- and observation-sleepers.
Note 4—Total for direct mechanical systems includes 323 cars on which the compressor is driven by a gas engine.

Wet-Bulb Thermostat Controls

Air-Conditioning Unit

THE Vitalized air-conditioning system of the B. F. Sturtevant Company, Hyde Park, Boston, Mass., consists essentially of a blower and spray-cooling unit, an ultraviolet-ray sterilizer, and a wet-bulb thermostat control.* The wet-bulb thermostat is designed to operate in conjunction with other control apparatus of any standard or special design for the control of temperature and humidity in passenger cars. Its function is to produce economy in ice consumption in cars equipped with ice-chilled-water air-conditioning systems and to reduce the maintenance of Freon of steam-jet-equipped cars by effecting more continuous operation.

The thermostat consists essentially of a small hard brass alloy reservoir to which a supply and return-water connection is made from the main spray nozzle water-pumping system through a small copper tube. This tubing is installed as readily as electric wiring since it can be bent around corners and connected with standard flared fittings. Insulation against sweating is provided by standard commercial hollow-sponge rubber tubing and felt where necessary.

A few drops of water each minute (depending upon evaporation) find their way from the reservoir into a special leather sack or boot which becomes uniformly wetted over its entire outer surface. This water evaporating from the surface cools the interior of the boot to the wet-bulb temperature of the surrounding air. A mercury thermometer inserted into the sack, therefore, records this wet-bulb temperature.

At a predetermined point in the stem of the thermometer, corresponding to a given wet-bulb temperature, a wire is fused through the glass to contact the mercury when it rises to the proper wet-bulb temperature. Thus an electrical connection is established and the circuit completed through a relay whenever the mercury is at the desired wet-bulb temperature or higher. When the wet-bulb temperature is lower the electric circuit is opened and the relay de-energized. The entire device is placed in the outside air intake opening of the passenger car so that at all times, while the air-conditioning system is in operation, the wet-bulb thermostat is subjected to an ambient temperature corresponding to the outside air.

The relay is in turn connected electrically into the main air-conditioning control panel to operate a damper motor which will change an automatic damper setting from approximately 25 per cent outside air to below 100 per cent outside air and vice versa. At all outdoor wet-bulb temperatures above the predetermined temperature the dampers will shift to admit 100 per cent outside air. Thus the car is provided automatically with 100 per cent clean, fresh, washed and filtered outdoor air at all times when weather permits and at all other times with 25 per cent outdoor air and 75 per cent recirculated, but still washed and filtered air.

At no time is the mechanical refrigeration apparatus beneath the car overloaded. In fact, it is kept in more continuous operation by the control since the dampers reset automatically under wet-bulb temperature control to maintain a more nearly constant load upon the evaporator.

Cars equipped with ice-chilled-water systems will cool by evaporative cooling and consume no ice for refrigeration during the period when the dampers are set automatically to 100 per cent outdoor air.

Standard coach control panel, including wet-bulb thermostat connections

An automatic water-regulating valve and a water strainer are provided with each wet-bulb thermostat. These devices need only occasional attention. Experience has shown that when properly adjusted the valve will regulate the proper water flow for an entire summer without attention and the strainer need be cleaned no oftener than once or twice a season.

The wet-bulb thermostat may also be used for regulation of the ultraviolet sterilizer at all times when the outside air dampers are set to the 25 per cent position. This would include the heating season and periods when mild weather conditions exist out of doors, such as in the spring and fall, and summer mountain weather at high altitudes. The relative humidity of the car may also be regulated uniformly without window condensa-

* A description of this equipment appeared in the December, 1937, issue of the *Railway Mechanical Engineer*, page 564.

tion under such weather conditions. Water freezing temperatures cannot damage the control and, in most installations, the water will dry from the leather boot and drain from the reservoir when the main pump stops long before freezing weather exists. The control will also regulate the ice-water bypass valve in cars equipped with ice-chilled-water systems so that water will not pass through the ice bin during the evaporative cooling setting of the outside air dampers. This is essential for ice economy. On mechanically refrigerated cars the control can be made to shut down the compressor completely when evaporative cooling is possible.

The principle of the application of the wet-bulb thermostat to railway cars depends upon the fact that the quantity of heat in air at any given wet- and dry-bulb temperature is determined by the wet-bulb temperature. In a conventional type of railway car full of passengers the usual maximum wet-bulb temperature of the air entering the evaporator coil (mixed outdoor and recirculated air) is in the neighborhood of 70 deg. F. The evaporator must cool this air to a wet-bulb temperature of approximately 55 deg. under maximum load conditions. The refrigeration tonnage rate requirement is determined as a function of the difference between these two wet-bulb temperatures.

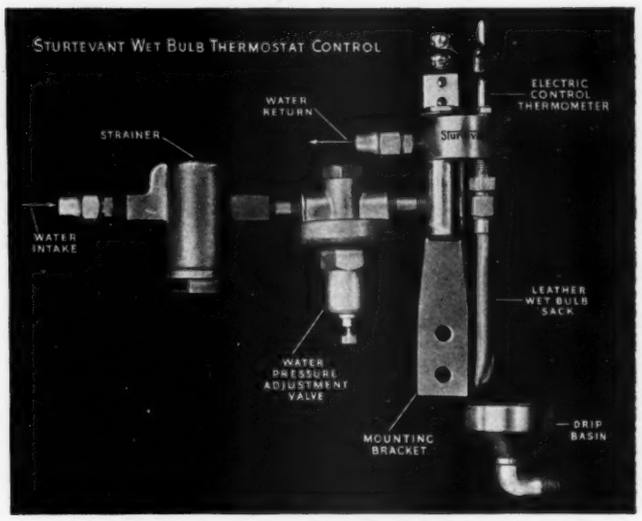
But there are many times when maximum conditions of outdoor temperature do not exist. If at such times a damper could be adjusted to admit outdoor air with no recirculated air and water sprays could be directed into intimate contact with the outdoor air to remove dust and secure the necessary benefit of evaporative cooling plus refrigeration, it would be possible to reduce odors and bacteria in the car by the very fact that the car would be ventilated by 100 per cent outdoor air, practically sterile and odor-free.

A 70-deg. F. wet-bulb temperature thermostat supplemented with water sprays and refrigeration will bring this about and make possible the introduction of 100 per cent outdoor air at all times when the outdoor wet-bulb temperature is low enough (70 deg. F. or less) not to overload the existing mechanical refrigeration apparatus.

Careful daytime studies of government weather bureau records indicate that trains running through territories in the vicinity of Philadelphia to St. Louis, to Dallas, Tex., or through regions north or west of this route can be operated with 100 per cent outdoor air under wet-bulb thermostat control slightly over 50 per cent of the time during a typical summer of June, July, August and September.

During the remainder of the time resort must be made to air conditioning with partially recirculated air. Under these circumstances the recirculated air and the outdoor air are then passed through the coils of the evaporator and washed with water sprays. The recirculated air is treated intensely with ultraviolet radiations to imitate the lethal action of sunlight upon bacteria and other micro-organisms. The ultraviolet sterilizer is said to produce a bacteriological result in a car equivalent to that which was obtained by the introduction of 100 per cent (approximately 2,000 cu. ft. per min.) outside air through the air-conditioning system into the car. The total power input to the sterilizer is about 12 amp. at 38 volts.

The ultraviolet sterilizer was first operated in railway service during the fall of 1937 after laboratory tests to establish the design had been completed. A careful check upon the apparatus in actual service at the end of the winter season disclosed remarkable agreement with laboratory tests and germicidal benefits from the lights as predicted. The regular sterilizer equipment produces no perceptible quantity of ozone, but when the presence of the small quantities of ozone found in mountain air are desired, special ultraviolet lights may be provided in combinations to meet any desired standards.



The wet-bulb thermostat control permits the admission of one-hundred per cent outside air in mild weather

It can be shown that the application of vitalized air conditioning to railway cars will result in a saving of maintenance expense of existing mechanical equipment through less frequent starts and stops. The conventional air conditioning system of today is designed for about six or seven tons per 24 hours' refrigerating capacity. Under such loads the compressor will operate almost continuously, but at other times the refrigeration load is reduced sufficiently to make it necessary for the controls to stop the compressor more or less frequently, depending upon the mildness of the day and the number of passengers in the car.

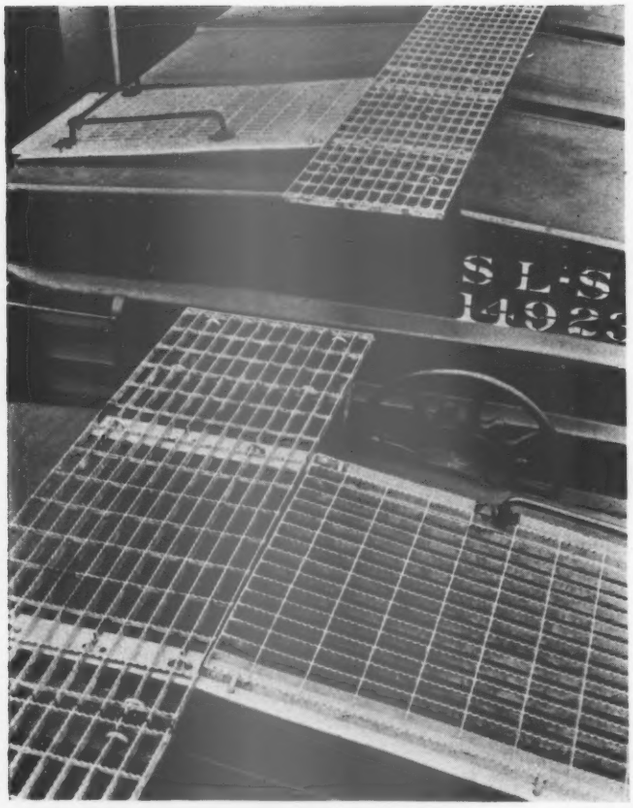
When the wet-bulb thermostat shifts the damper setting to 100 per cent outdoor air, the effect or recirculated air upon the operation of the system is, of course, removed. Under such circumstances a more continuous operation of the compressor equipment is made possible. Furthermore, the compressor equipment will shut down completely, allowing the water sprays to exert a cooling action by evaporative cooling under mild weather conditions and in favorable sections of the country.

Savings because of the absence of the need of removing evaporator coils and blowing them out with steam or chemicals to render them free of odor-producing collections of scum and algae growth are indicated. It is also expected that less frequent cleaning of the air ducts will be necessary.

Apex Safety-Steel Running Board

A new type of metal running board for all kinds of box cars, as well as running boards for locomotives and locomotive tenders, has recently been developed and placed on the market by the Apex Railway Products Company, Chicago.

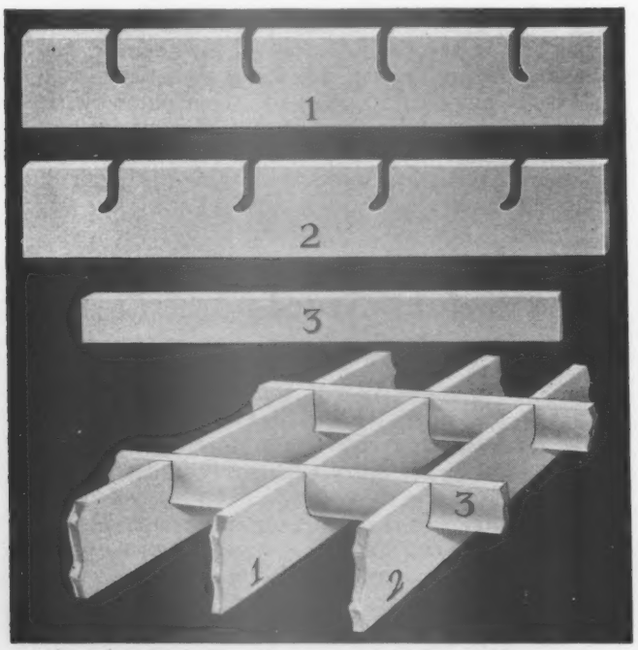
This running board is of the grating type with both the longitudinal and latitudinal bars serrated to assure safe footing for trainmen and other employees, regardless of weather conditions. The running board utilizes the Tri-Lok method of fastening the bars together, the Apex Railway Products Company having been exclusively licensed by the Tri-Lok Company, Pittsburgh,



Details of application—note the serrated top surfaces

Pa., to use this method of construction in making running boards for use on all railroad rolling stock.

In assembling, the bearing bars are set on edge with a series of J-slots uppermost and with these slots in adjacent bars curving alternately in opposite directions. Each bar is held in a rigid steel frame assuring accurate alinement. Cross bars of the same depth and width as the bearing bar slots, are then forced into the slots, under a 1,600-ton press. This completes the triple twist and turn lock from which the name Tri-Lok is derived.



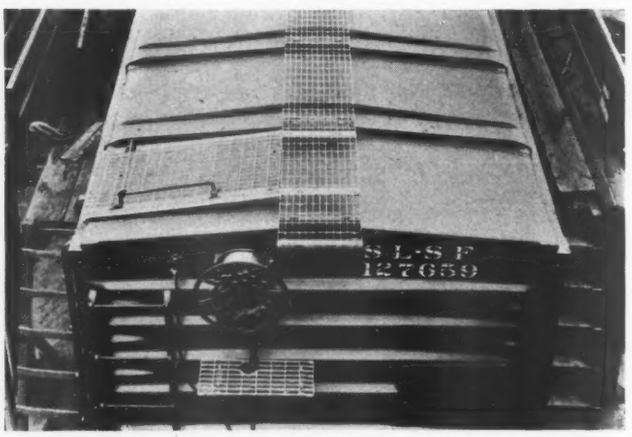
Principle of construction of the Apex tri-lok running board

The Tri-Lok bearing bars are not punched or cut below the neutral axis, so that the strength of the lower or tension side is unimpaired. The wedge action from forcing the cross bars into the curved locking slots is said to increase the strength of the upper or compression side and hence make the load-carrying capacity of the bearing bars greater than that of corresponding solid bars.

The cross bars are of sufficient depth to eliminate lateral deflection of the bearing bars and, because of the rigid lock at the joint, they act also as cross braces giving an even distribution of a concentrated load over a wide panel. The rigidity of this construction permits the use of light sections, with the result that this metal running board is, in certain cases, even lighter than the standard wooden running board.

The material is made up of 0.25-per cent carbon, copper-bearing steel and the separate units which make up the complete running board are hot-dipped galvanized after the entire assembly has been completed. It is estimated that this running board will last the life of the car without maintenance costs of any kind.

The serrated top surface of this running board presents a safe walking surface regardless of weather conditions. The serrations are sufficiently sharp to crush sleet or ice under a man's weight, and the spacing be-



Apex tri-lock running board and handbrake step applied to a box car

tween the bars is sufficient to furnish an available hand hold in case of emergency. It is likewise claimed that this running board will be self-cleaning due to the fact that it presents a 90 per cent open area. Under ordinary conditions it will be impossible for snow to collect to a sufficient depth to cover the serrated walking surface.

The Apex Tri-Lok running board consists of seven sections on a standard 40 ft. car. The five center sections are approximately 81 in. long and are spaced ¼ in. apart. The end sections vary according to the exact dimensions of the car and are purposely kept smaller to insure lower replacement costs in the event that the car is cornered in service.

These sections can be attached to the standard saddles now in use and the method of fastening will make possible the use of standard A. A. R. ⅜-in. bolts or rivets. The application of this type of running board entails the use of 63 standard ⅜-in. bolts complete with lock nuts as compared to 90 ⅜-in. by 1¾-in. water-tight, slotted head bolts and 12 ⅜-in. by 2-in. water-tight, slotted head bolts used on the wooden running board.

Latitudinal or transverse running boards and the hand brake steps or platforms, are also furnished by the Apex Railway Products Company in the same general type of design.

EDITORIALS

Some Light on Deferred Maintenance

According to a report of the Interstate Commerce Commission, based on the replies to a deferred-maintenance questionnaire which was sent out in December, 1938, the Class I railroads had deferred maintenance at the end of 1938 amounting to $283,820,000, which would need to be made up in order to put the properties in normal condition to handle during the current year a volume of traffic as large as that of 1937. The report further indicates that $495,757,000 should be expended during the three-year period 1939 to 1941 for additions and betterments and extensions to enable the carriers to handle this volume of traffic more cheaply and expeditiously. Of the $283,820,000 of deferred maintenance, an average of only $73,676,000 per year, or a total of $221,027,000, would need to be made up during the next three years. The questionnaire further asked how much these totals would be increased if a traffic 10 per cent greater than that of 1937 were assumed for 1939. The replies indicated an increase in the amount of deferred maintenance of $94,852,000 and an increase in the amount needed for additions, betterments and extensions of $19,991,000.

Of the $283,820,000 of deferred maintenance reported, $84,173,000 was for repairs to existing cars and locomotives and $37,276,000 was for additional equipment. More new equipment was also included in the $495,757,000 reported as the needs for additions and betterments. Deferred maintenance of shop machinery and tools is reported in the amount of $3,574,000, of which slightly less than $2,000,000 would be charged to investment. This also is in addition to expenditures for new shop machinery and tools included in the $495,757,000 of additions and betterments.

As pointed out by one of the railroads in its report to the Commission, "current expenses for maintenance compared with expenditures for past years are no criteria for determining whether any deferred maintenance has accrued because of larger and improved machines installed in recent years as well as improved methods now used for doing maintenance work which were not previously available." Selected statistics, included in an appendix to the report which relate to maintenance from 1929 to 1937 on the large steam railroads with annual operating revenues above $25,000,000, throw considerable light on this phase of the situation. As a measure of the transportation performance by which the need for maintenance expenditures is created, 100 car-miles has been chosen as a unit. Man-hours paid for in maintenance of equipment and stores is selected as an index of the amount of maintenance put back into the equipment. The trend of this ratio since 1929 for the Eastern, Southern and Western Districts is shown in the table. Assuming that there had been no change in maintenance efficiency, the reduction of man-hours per 100 car-miles during the years since 1929 indicates roughly a volume of deferred equipment maintenance amounting to about $1,000,000,000. The total figures for deferred maintenance of equipment in the report, including both the requirements for repairs and for new equipment, amount to $121,500,000—about one-eighth of the hypothetical total.

It is, of course, reasonable to assume that, if the standard of comparison were a condition of the property equal to that existing in 1929, the amount of deferred equipment maintenance shown would be greater than the $121,000,000 represented by a prospective volume of traffic equal to that of 1937. Much of this would be additional equipment required to restore the capacity of the property to that available in 1929 and would be necessary because of extensive retirements unbalanced by adequate acquisitions of new units of equipment during the intervening years.

A point of particular interest in the report is the fact that, of the 115 replies received, only 67 replies are represented in the deferred maintenance total, of which 44 were for railroads or systems not in the hands

The Trend of Maintenance of Equipment Expenditures in Relation to the Volume of Transportation Service

	1929	1930	1931	1932	1933	1934	1935	1936	1937
Eastern District									
Car-miles in transportation service (000,000)	13,652	12,001	10,269	8,221	8,291	8,666	8,688	9,742	10,162
No. man-hours per 100 car-miles (Maintenance of equip. and stores)	3.62	3.47	3.21	3.05	2.87	3.01	2.92	3.09	3.09
Maintenance of equipment expenses (000,000)	571	475	376	281	270	285	300	357	374
Southern District									
Car-miles in transportation service (000,000)	6,299	5,731	4,927	3,890	4,079	4,316	4,357	4,969	5,169
No. man-hours per 100 car-miles (Maintenance of equip. and stores)	3.50	3.24	3.04	2.93	2.72	2.90	2.74	2.74	2.71
Maintenance of equipment expenses (000,000)	212	181	150	113	113	121	133	144	150
Western District									
Car-miles in transportation service (000,000)	13,701	12,330	10,345	8,205	8,194	9,155	9,413	10,801	11,442
No. man-hours per 100 car-miles (Maintenance of equip. and stores)	3.16	2.94	2.69	2.58	2.44	2.43	2.46	2.45	2.52
Maintenance of equipment expenses (000,000)	421	364	292	225	215	232	248	282	303

of the courts, and 23 for properties in receivership or trusteeship. The report questions the validity of returns indicating no deferred maintenance for so many roads, on the presumption that they may have understood the term "deferred maintenance" as used in the questionnaire in too narrow a sense. It arrives at a total of $444,000,000 by assuming amounts of deferred maintenance for these roads on the same percentages of their operating revenues as were averaged by the reporting roads.

Aside from the very material increases in the efficiency of equipment maintenance which have been developing throughout the past ten years, a considerable volume of deferred maintenance has been permanently removed from the future requirements for repairs by the accelerated rate at which both freight cars and locomotives were retired during the depression years. This will, of course, appear progressively as demands for new equipment when traffic volume catches up with and begins to exceed the capacity of the present equipment inventory.

While the report does not show the full amount of deferred maintenance suffered by the railroads since the beginning of the depression, it probably presents a good idea of the practical needs of the properties to meet the conditions likely to be faced within the next year or so. With a return of some measure of prosperity to the railroads, much more would be spent in raising the general standards of maintenance to higher levels than those now prevailing, which represent the minimum needs for safety and a capacity only just sufficient for the immediate future.

Fewer Machine Tools And Tool Supervisors

The general trend, both in the installation of modern machine tools in railroad shops, and in the provision of an adequate number of tool foremen or supervisors to develop needed accessory equipment and keep present jigs, fixtures, cutting tools, etc., in good working condition, has been downward for a number of years past. According to a recent report of the United States Bureau of the Census, 291 companies were engaged in the manufacture of machine tools in this country during 1937. How many railway machine foremen and even general supervisors of shop machinery and tools know *all* of these companies; understand or appreciate the adaptability of their respective products to railway shop operation; and are in a position to give a reasonably accurate estimate of the attendant economies?

The total value of all machine tools manufactured in 1937, including replacements and repair parts, is given in the Bureau of the Census report as $216,000,000. Figures compiled by the Interstate Commerce Commission, Bureau of Statistics, show that Class I railroads spent only $6,710,000 for new shop machinery chargeable to additions and betterments in 1937. Further curtailments of railway machine tool purchases took place in 1938, as shown by a recent *Railway Mechanical Engineer* study which indicated that 15 new boring machines, 21 drilling machines, 32 engine lathes, 8 milling machines, and other tools in proportion, were installed during the year. Both railroads and railroad shops are "tinctured with a public interest," and, therefore, must continue to operate on a long-time basis. This means that deficiencies in rolling stock and the machinery required to maintain it may, on account of financial stringency, be allowed to accumulate for a number of years, but, in the long run, must be largely made up. The record of relatively few machine tool purchases in recent years is evidence in itself of a condition of shop machinery obsolescence which in the end will have to be corrected.

Equally important with the mechanical tools and equipment which should be installed to bring railway shops up-to-date is the provision of an adequately trained and experienced supervision to make sure that full advantage is taken of modern shop tools and machinery when placed in service. Without competent supervision to assure proper operation and develop special tooling equipment required in railroad shop machining operations, it is obvious that expected economies will not materialize. Have shop supervisors, including general foreman, enginehouse foremen, machine foremen and tool foremen been encouraged to study machine production methods, read technical publications in this field, visit well-equipped plants and thus become familiar with the latest and best practices not only in other railroad shops but in manufacturing plants where similar operations have to be performed? The answer must be, in general, No. Railroad supervisory forces have been cut to the bone, many individuals reduced in rank and the position of tool foreman pretty nearly abolished.

The fact just stated is, of course, responsible for the practically complete discontinuance of the American Railway Tool Foremen's Association, which could not get enough active members to continue its meetings subsequent to 1930 and had to "shut up shop." This association has in the past done some excellent work in the interests of economy on the railroads and at its last meeting was engaged in standardizing certain small tools which promised to be a constructive service not only to the railroads but to the manufacturers, who expected to be able to supply improved standard tools at reduced cost. It is unfortunate that this work had to be discontinued and also that the association could no longer serve as a clearing house for ideas regarding shop machinery and tool improvements.

Tool foremen, in the nature of things, are responsible for the development of many of the special jigs, fixtures and attachments which serve to increase the productive capacity of machine tools and reduce the unit costs. The proper maintenance of this equipment, as well as the task of specifying cutting tools which

will produce desired results at the least cost, and keeping these tools in condition for efficient use, constitutes a real problem which confronts all tool foremen. It is a distinct detriment to railroads to lose the services of these men, or lower their morale by reducing them to the ranks and expecting them to do more or less the same work at reduced pay. Such action may be temporarily forced by a drastic retrenchment program, but should obviously be "reversed and remanded" at the first opportunity.

Nine Years Progress in Railway Air Conditioning

Almost 10 years ago, in September 1929, the Pullman Company placed in service the first air-conditioned passenger car to be operated in this country and seven months later the Baltimore & Ohio equipped the diner "Martha Washington". In April 1932 the Baltimore & Ohio inaugurated the first completely air-conditioned train, the National Limited. These were the events that introduced a new era in passenger transportation by rail during which the Pullman Company and the roads of this continent have equipped 11,676 passenger cars at an expenditure in excess of 80 million dollars.

On page 139 of this issue there appear, for the sixth consecutive year, the tabulations of the passenger cars that were equipped with air conditioning apparatus during the year 1938 and a summary of the installations for the entire nine-year period of this development. These statistics are interesting because they not only show the extent and character of the work that has been done in this field but they show the trends as experience with air conditioning broadened.

A study of these figures indicates that 67 per cent of the cars owned by the Pullman Company are now air-conditioned and, incidentally, the total number of air-conditioned Pullman cars at the end of 1938 represented over 97 per cent of the Pullman cars operated in 1938. From the railroad standpoint the total installations represent about 23 per cent of the passenger-carrying cars owned by U. S. roads. Of the 5621 railroad-owned air-conditioned passenger-carrying cars (exclusive of Canadian equipment) 3,126 are coaches, 387 are combination cars and 1,309 are grouped together as dining, chair, sleeping, club, lounge and observation cars. These represent, respectively 17 per cent, 12 per cent and 90 per cent of their classifications owned by U. S. roads. It is obvious that there is a lot of work still to be done in extending the comforts of air-conditioned travel to the coach passenger.

Of the 11,676 cars in service in North America 51.5 per cent are equipped with mechanical refrigeration systems, 35.5 per cent with the ice-activated system and 13 per cent with the steam ejector system. Of the 6,034 cars equipped with mechanical systems all but a very few of the early cars use Freon as a refrigerant. Over 300 cars have gas-engine-driven compressors.

New Books

FORGING PRACTICE. *By Carl G. Johnson, assistant professor of mechanical engineering, Worcester Polytechnic Institute. Published by the American Technical Society, Drexel avenue at Fifty-eighth street, Chicago. Price, $1.50. 136 pages, illustrated.*

How and why certain physical changes occur within metal being worked, and how the results produced by forging can be controlled not only as to shape, but also as to structure and physical properties in the finished forging, are discussed in Forging Practice. Many other phases of plastic shaping are considered in the book which is a practical treatise on hand forging of wrought iron, machine steel and tool steel; drop forging; and heat treatment of steel, including annealing, hardening and tempering.

OXYACETYLENE WELDING. *By Robert J. Kehl, M. E. Revised by Morgan H. Potter, B. S., instructor in charge of welding, William Hood Dunwoody Industrial Institute, Minneapolis, Minn. Published by the American Technical Society, Drexel avenue at Fifty-eighth street, Chicago. 126 pages, illustrated. Price, $1.25.*

The material in the revised edition of Oxyacetylene Welding has been written for the welding operator as well as for the superintendent and manager. It is written in the "how-to-do" style and the examples it contains have been taken from many industries. The thirteen chapters in the book are on the Oxyacetylene Process, Technique of Oxyacetylene Welding, Welding for Different Metals, Steel Welding, Cast-Iron Welding, Welding at Vertical and Overhead Positions, Pipe Welding, Miscellaneous Processes, Welding Miscellaneous Metals, Cutting and Lead Burning, Welding in Automobile Repair Work, Design of Jigs for Oxyacetylene Welding, and Costs.

CAR DEPARTMENT OFFICERS' PROCEEDING. *Published by the Association; bound in cloth and comprising 162 pages, 5 in. by 8½ in. Secretary-Treasurer F. L. Kartheiser, chief clerk-mech. Chicago, Burlington & Quincy, 547 W. Jackson boulevard, Chicago. Price $2 (including annual membership dues).*

Containing the official proceedings of the second annual meeting of the Car Department Officers' Association at Chicago on September 27 and 28, this well arranged and carefully edited book presents a large amount of information of value to railway car foremen and supervisors of all ranks. The discussion of various important details of car construction, included in this book, is particularly pertinent. Other reports deal with such subjects as: shop operations, facilities and tools; passenger train car terminal handling; lubricants and lubrication; freight-car inspection and preparation for commodity loading; interchange; loading rules; and billing for car repairs.

THE READER'S PAGE

Exchange Ideas on Equipment Maintenance

To the Editor:

Through the medium of the columns of the *Railway Mechanical Engineer* there appears to be a valuable opportunity for exchanging ideas relative to equipment maintenance. I have always felt that real sympathy should exist between kindred departments on all railroads, which in turn would bring about this exchange of ideas and ultimately result in establishing the most efficient and economical method of operation.

I write primarily from an air-brake standpoint. The average air-brake department is left very much to its own resources and, on account of the intricacies and technical difficulty of the work involved, is avoided very much by many who could be of real help. It therefore becomes more or less like Topsy who "just growed up."

We are now entering upon a new era in so far as the air brake is concerned; namely, the adoption of the Type AB brake as standard on all freight cars by January 1, 1945. When the entire ownership of approximately 1,950,000 freight cars is so equipped, it will represent an investment of about $328,029,000. This enormous sum of money can and should be made an investment upon which good returns will be realized, but to do this will require both proper organization and proper equipment. The object of such organization should be efficient, safe, and economical maintenance, and this is where the exchange of ideas becomes a most important factor in attaining the desired result.

Why should we be jealous of, and refuse to share with, our neighbor something that we have discovered that helps us in our work? Can't we realize that by helping others we are helping ourselves; this being accomplished by reinforcing and perfecting the entire structure of maintenance?

In the September, 1937, issue of *Railway Mechanical Engineer* there were illustrated several ideas that we had developed and had proved to be very efficient in making repairs to the Type AB valve. We thought that, inasmuch as these tools had helped us, their extended use would surely help others, so we passed these ideas on. We then patiently waited for each succeeding issue of the magazine, hoping to find something described therein that would help us in this AB valve maintenance. In other words, we expected to find a real spirit of reciprocity, but up to date nothing has appeared and I am wondering whether it would not be a good investment of time and money if a kind of clearing house for ideas were established, a place where all methods of maintenance would be collected, thoroughly analyzed by practical men, and the best way determined and made uniform standard practice. A procedure of this nature would also be a boon to safety, as it would be possible to cull out all unsafe practices.

Assuming an ownership of 50,000 cars on an individual railroad, over $100,000 will be spent annually for maintaining the AB brake, as per A. A. R. Rule 60. This sum represents the money that will be spent to protect an investment of $8,411,000, which is the approximate cost of 50,000 car sets of AB brake equipment. Surely an investment of this magnitude should invite serious thought and particularly the co-operation of all air-brake maintenance men, to the end that air-brake equipment will be kept up to the highest point of efficiency at the lowest possible cost. This can be done only by exchanging ideas so that ultimately only the best practices are used.

I feel sure that the *Railway Mechanical Engineer* will gladly open its columns for this exchange of ideas, with sketches of devices, and other valuable information gleaned from the experience of maintaining the AB brake equipment, and it is hoped that such invitation will be extended so that we all may profit from the various experiences gained from the work.

T. H. Birch,
Air Brake Foreman,
Chicago, Milwaukee, St. Paul & Pacific

Compensation for Worth-While Ideas

To the Editor:

Your editorial in the February issue, page 63, relative to "The Patent Problem," is indeed pertinent and should receive the careful perusal of every railway executive who has the responsibility of assisting in the development of the industry.

Certainly some consideration and encouragement should be given the inventor of devices that improve or provide economy and safety in mechanical performance. This, of course, refers to those inventions having commercial possibilities as well as domestic application.

If the railroads are to keep pace with other modern means of transportation, new devices must come into use to offset competitive transportation facilities, which are continually improving. While competent professional designers do contribute, they cannot think of everything. The man in overalls may have a splendid idea, but unless he is encouraged to develop it with fair remuneration for his painstaking efforts, it is likely to remain just an idea.

Just as patent monopoly by manufacturers stagnates progress, so, too, does the indifferent attitude of management to the ideas of employees. True enough, the "suggestion box" is some encouragement, but only for small ideas with small remuneration. Certainly an inventor after much study and painstaking effort, will not entrust an idea with commercial possibilities to the discretion of those in charge of the "suggestion box." He will take the matter up with those whose duty it is to consider it for the benefit of the industry, and, if he receives no encouragement, he will probably patent the idea at his own expense, only to find that his troubles have just begun. You may be sure that after he is thoroughly disillusioned he will waste no more time on ideas that require study and painstaking effort.

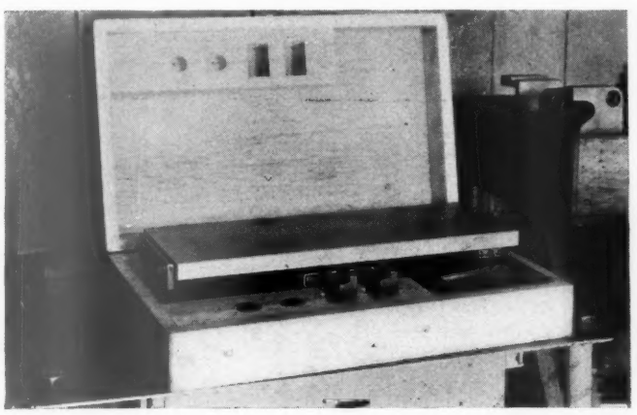
We have reached the "frontier of research, new discoveries, new inventions," but we must go on. "This frontier need never be closed." The ideas of the individual are needed to expand it. I hope you will continue to write editorials on this subject.

F. R. Richard

IN THE BACK SHOP AND ENGINEHOUSE

Permanent Type Magnetic Chuck

An interesting and valuable new tool, recently installed in the tool room of the Union Pacific locomotive shops at Omaha, Neb., is the Brown & Sharpe magnetic chuck, illustrated. This chuck, which is of the permanent-magnet type and requires no electrical connections, has a working surface 6½ in. wide by 18 in. long and is operated simply by turning a handle on one end 180

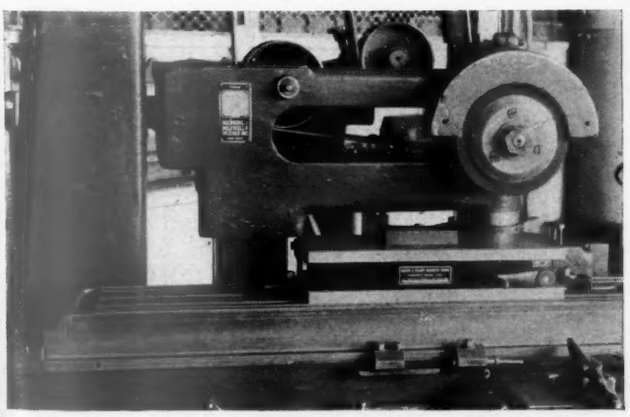


Convenient wooden box designed for the safe keeping and handling of the permanent magnetic chuck and its associated parts

deg. from the *Off* to the *On* position. The operation of moving parts within the chuck body serves to short-circuit the lines of magnetic force and release the metal part being machined, or leave the lines of force unbroken and hold the part firmly against the upper surface of the chuck, dependent upon which is desired.

The convenience of this magnetic chuck, with complete absence of electrical connections, is readily apparent and it can be clamped on the work table of any ordinary machine tool or surface-grinding machine by means of two dogs and T-slot bolts, as illustrated. The chuck is particularly useful when taking finish-grinding cuts on such parts as wheel-lathe forming tools, shear blades, etc. In one of the illustrations, the chuck is shown on a Thompson grinder holding a special forming tool used in machining passenger car center castings. For light grinding operations, no positive mechanical stop is required to supplement the holding power of the magnet, but it is advisable to use the stop when taking light milling cuts.

This magnetic chuck is also useful at work benches in holding various parts while being filed, especially thin material which would be difficult to clamp in a vise. Referring to the second illustration, the special wood box with hinged cover, which is used to hold the magnetic chuck and associated parts and keep them safe at all times when not in use, is shown. The provision of this box may seem like a small and unimportant detail, but it is in line with the fixed policy in this particular railway tool room of taking the best care possible of the many highly-accurate and finely-finished tools, gages, etc., which experience has shown that it pays to buy and use, in spite of their relatively high first cost.

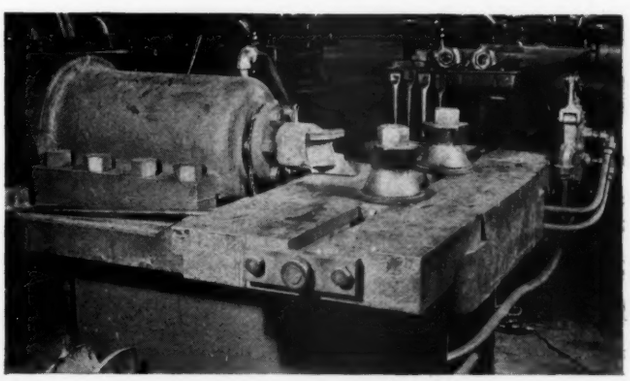


Brown & Sharpe magnetic chuck of the permanent-magnet type used in finish grinding a special forming tool

Hydraulic Pipe Bending Machine

The accompanying illustration shows a hydraulic pipe bending machine designed for the cold bending of various sizes of pipe. Any size pipe, up to and including 4 in. extra-heavy, can be successfully shaped cold.

The cylinder has a bore of 12 in., and is fitted with a



Machine for bending pipe cold

piston having the usual hydraulic packing leather for forward and return stroke. The 4-in. piston rod was made from an old locomotive piston rod.

In order to bend the different sizes of pipe, cast iron bending dies are made to suit each size of pipe. These slip on to the end of the piston rod and are held in place by a pin. In order to get bends of different radii, the two spools are mounted on a steel nut with a spindle. The nuts are threaded right and left hand so the spools can be placed any distance apart to obtain the different

(*Continued on page 155*)

by
Walt Wyre

Carter stood several seconds looking at the foreman without saying anything

OLD DOG — NEW TRICKS

"RAILROADING ain't what it used to be," John Harris, roundhouse clerk for the S. P. & W. at Plainville, remarked.

"No, and if you ask me, it never was," Jim Evans, the roundhouse foreman, replied as he dropped the only portion of his anatomy that wasn't tired in a chair.

"What I mean," Harris explained, "there's more paper work than there used to be; more reports to make out, more correspondence."

"Yes," Evans agreed wearily, "and they run locomotives further and faster and pull bigger loads. Work has to be done better, too. A locomotive patched up with hay wire and half a dozen leaky flues stopped with hickory plugs can't stand the gaff now."

Evans felt in his pocket for a cut of "horseshoe." He eyed the plug reflectively. "A roundhouse foreman makes nearly as many miles a day now as a locomotive did then. Now we start a locomotive out on a 1,600-mile run and if there's a five-minute delay with a hot trailer brass, the roundhouse foreman gets more letters than Charlie McCarthy!" Evans wrenched off a corner of the plug of "horseshoe" and settled himself back in the chair.

The foreman picked up a copy of a railroad shop paper, and began thumbing through it until he came to an article about failures caused by broken pins and rods. The illustration attracted his attention first. Some of the breaks shown were almost identical with ones he had experienced in a recent epidemic of such failures.

Evans propped his feet up on the desk and prepared to read in comfort. He had about half finished the article and was too much interested to notice when H. H. Carter, the master mechanic, came in.

Carter stood several seconds looking at the foreman without saying anything, until the clerk said good morning.

The master mechanic grunted something that was evidently intended as a return of the greeting. Evans looked up with a jerk. The magazine dropped to the floor and the foreman's feet followed closely behind.

"Sorry if I disturbed you," Carter said with a touch of sarcasm. "What you were reading seemed to be very interesting."

"It is," Evans replied. "It's an article about broken pins and rods."

"Well, seems like we've had enough of them around here without reading about the ones on some other railroad." The master mechanic looked at Evans accus-

ingly. "That's one thing I want to talk to you about. The 5077 broke a main pin, you know."

"Yes," the foreman replied, "she's in the house. Tore herself up pretty bad. I had the storekeeper wire for repair parts." Evans picked up the paper as unostentatiously as possible and laid it on the desk.

"Another thing," the master mechanic said, "the superintendent is raising hell about the gas bill. You know ever since we put in gas here the bill has been getting higher each month."

"Yes," Evans replied, "we are using it for a lot of other things besides firing locomotives—heating tires, melting babbitt, heating rivets, and the pipe-fitters use it for heating pipe."

"It's got to be cut down." Carter started to the door. Evans rose and went with him.

The 5081 that had just come in was standing at the engine washing rack. A laborer was washing the working parts of the engine. The master mechanic walked over to see how well the job was being done.

Cleaning the working parts of a locomotive to facilitate inspection and repairing has long been a hobby with Carter. Getting the job done properly has been as perplexing as finding a permanent solution for the relief problem is to Congress.

The laborer was washing the right cross-head and guides and seemed to be doing a pretty good job. The master mechanic walked over a little closer. The pipe and nozzle he was using didn't seem as clumsy and heavy as ones Carter had noticed before.

The official edged nearer for a better look. The laborer turned the nozzle just enough to direct the high pressure spray against the flat surface of the main rod. A pool player would have called it a perfect bank shot; a soldier would have called it a ricochet; what Carter called it wouldn't pass in print. The hot mixture of water, steam, and cleaning compound splashed the master mechanic from head to foot.

Evans strangled on the tobacco juice he swallowed. The laborer pretended he had never seen the master mechanic and kept right on washing the engine.

"Is that a new outfit?" Carter asked after he had mopped himself with a piece of clean waste.

"Not exactly," the foreman replied. "It's part new."

"It's doing a good job. Where did you run across it?"

"In your magazine," Evans told him. "I just happened to be looking through some back issues and found an article on cleaning locomotives. I wanted to try it out before I said anything about it. We've tried so many that didn't work."

"Well, that one seems to do a good job, all right," the master mechanic agreed.

THE two men went into the roundhouse, walked through, pausing occasionally to inspect a job or look at some part of a locomotive.

From the roundhouse they went into the machine shop. The wheel lathe operator was turning a pair of driving wheel tires.

"How long does it take to turn a set of tires?" Carter asked.

"Oh, about six pairs a day," the foreman replied.

"That's an hour and twenty minutes to the pair!" Carter exclaimed. "Why, in lots of places they turn out a pair every hour. What's the matter? Can't Jenkins run that wheel lathe?"

"Yes," Evans said, "and he can turn tires as fast as the next one, but sometimes speed is not the only consideration."

"That's all except getting the proper size and shape."

"That's what I thought, too," Evans said, "until I ran across a short article that started me thinking about it. You see, based on a cost of $100, which is approximately what a new tire costs, each sixteenth of an inch of the usable part of a tire is worth around five dollars. When turning tires at high speed, I found that something like a sixteenth of an inch more was taken off than we do now. On a set of eight tires, that's around forty dollars."

"Sounds reasonable," Carter said, "but I never thought of it that way before. I'm going to do a little figuring on it."

The master mechanic went to his office. Evans stayed in the machine shop a few minutes, then went to the roundhouse.

He was still there when the clerk came out looking for him. "The despatcher wants a 5000 for an extra west at 3:15," the clerk said.

"Wonder why he didn't say something about it when I was talking to him about an hour ago," Evans said. "I could have given him the 5082 then. It could have made one more trip before the drivers were dropped. Now she's stripped clean as a bubble dancer. Give him the 5077 and ask him if he can't make it 3:45," the foreman added as he started to the roundhouse to rush the work up on the engine.

Work was progressing fairly well on the 5077. The machinists would be finished by the time the engine could be fired up. The fire builder was told to put a fire in her and get it hot soon as possible.

Starting a fire in the locomotive didn't take long. The boiler was already filled. The fire builder unscrewed a plug in the front end of the oil burner and connected a one-inch pipe that was fastened on to a heavy hose for the gas.

The fire builder yelled a warning, "Look out for a fire on the 5077!"—waited a moment then opened the gas valve. A blazing bunch of oily waste thrown in the firebox before opening the valve ignited the gas and the fire was started.

As Evans watched the fire builder he thought of the days when he was building fires many years ago. Then the S. P. & W. was using coal. When he bedded a firebox down preparatory to starting a fire, he made every scoopful count. Now a fire builder connects up a pipe, lights a wad of waste, throws it in the firebox, and opens a valve. The foreman shook his head. "No wonder gas is wasted," he thought aloud.

Everything seemed to be going about as well as usual in the roundhouse and Evans decided to take advantage of the opportunity to go back to the office and finish reading the article he had started.

MOST railroaders that have come up the hard way don't, as a rule, take much stock in technical explanation of cause and result. The idea of a testing engineer using a bunch of gadgets in an office to explain why a main pin broke just naturally goes against the grain. The old adage "he that is convinced against his will is of the same opinion still" holds good in many instances, but Evans is an exception. When he first started following the series of articles about the causes of failures of locomotive parts, he had, figuratively speaking, emitted a raucous raspberry for the writer. The very idea of a tiny tool mark a few thousandths of an inch deep causing a hugh main rod to break seemed ridiculous, until one day he was in the locomotive carpenter's shop.

The carpenter was replacing a broken glass in a wind deflector. The glass used is heavy plate. There was no glass of suitable size available and the carpenter was cutting a piece—breaking would be the more suitable

word. Evans thought as he watched. The carpenter scored the glass by drawing the cutter across it once, then tapped it lightly and it broke sharp and clean where scored.

That, of course, was an exaggerated example as compared with a broken rod, but it started the foreman thinking. From that time he began to examine broken parts more closely in an effort to determine the cause.

Evans may be hard-headed, but he is honest. In time he became convinced that the testing engineer knew what he was talking about. Other articles in the magazine strengthened his conviction.

The magazine had provided a solution for many perplexing problems. For example, handling driving-boxes with the overhead crane had always been something of a nuisance. One day looking through an issue he saw a short article telling how to build a pair of tongs for handling driving boxes. He had some built and they got the job done.

A jig for machining driving-box hub plates in the boring mill reduced the time required nearly fifty percent, as did a jig for machining boiler-check goose necks, clamps for lifting tires, a better method of chasing threads on washout plugs, and dozens of other ideas that could be used to advantage in roundhouse and shops he found in the magazine.

Evans is about as capable as most railroad foremen. He has had lots of experience but if every one depended entirely on individual experience they would never have time to learn a lot of things they need to know. If every roundhouse or shop foreman could visit every other shop or roundhouse, the chances are something of value would be learned at every place visited. That is an impossibility. The publication which serves his field is the magic carpet that allows the supervisor and officer to visit other places while sitting in an easy chair.

WHEN Evans first started reading the magazine he had the idea that most articles were of a theoretical nature and written by men who had obtained their railroad experience in a parlor car. That was before he became a contributor. Evans had worked out a method for laying out shoes and wedges that is good. Some one suggested that others might be interested in learning the method. Finally he was persuaded to write an article telling how he did it.

Most railroad men are handier with a hammer and chisel than with pen or typewriter. Evans is no exception and his rating as an artist would be preceded by a minus sign.

The clerk typed the article, corrected most of the misspelled words and dropped in a few commas here and there with an occasional semicolon for variety. Evans made some rough sketches that he hoped some one besides himself could understand.

After it was finished, Evans read the article over, looked at the drawings, and pitched the whole thing in the waste basket.

John Harris, the clerk, wasn't going to see all of his work go for nothing. He retrieved the typewritten pages and mailed the whole thing to the editor.

About a month later, Evans picked up a copy of the current issue of the magazine. He was turning the pages when he saw some illustrations that seemed familiar. Then he saw his own name under the title.

"The fellow that made these drawings from what I sent in sure knows his stuff!" Evans held the magazine for the clerk to see.

"Yeah, they look good," Harris said. "The article sounds good, too. I read it," he added.

"Yeah, I guess you must have mailed it," Evans said, trying to pretend that he was annoyed. "But it does make a pretty good article," he admitted.

After that, Evans felt that he had a part in the magazine. He sent in several other ideas for improved methods. Every time one appears in print he is surprised to see how much better they appear than he expected.

BETTER cleaning of motion work enabled inspectors to detect incipient cracks that would have been unseen before. Failures from broken rods became less frequent. A little more attention to machining pins, together with more rigid inspection when rods were removed, reduced the number of failures from that source. The foreman was congratulating himself over engine performance when he received a letter from the master mechanic.

The letter quoted from one written by the superintendent of motive power. "The amount paid for gas has steadily increased each month," Evans read. "It is entirely too much and must be reduced."

Below was a paragraph dictated by the master mechanic. It was brief and to the point. "In conversation with you some time ago, I pointed out that gas bills at Plainville are too high. You must take immediate action to see that a reduction is made."

"Phew!" Evans whistled, "the gas is getting him hot under the collar. Wonder if he thinks I am a gas combustion engineer!"

The foreman found a water service man. "I want you to go over all the gas lines and see if you can find leaks anywhere. We are using entirely too much gas."

A few leaks, none of them large, were found and corrected. Evans cautioned every one to be careful in the use of gas. The next month's bill was a little lower than the one preceding it, but there wasn't enough reduction to satisfy the officers.

Evans was in his office trying to figure out further reductions in the gas when he noticed a new copy of the magazine. He couldn't resist the temptation to declare a recess from worrying long enough to see what was in it.

The use of natural gas in round houses has materially increased in recent years, but most generally in areas near gas fields where the cost compares favorably with other fuels. As a result, a great deal has not been written on the subject. Evans was agreeably surprised to see an article on gas burners for railway shop use.

He was reading the article when the master mechanic came in. "Well, maybe that explains why we are not making any showing on gas bills," Carter snapped. "The superintendent called me down to the office yesterday and gave me to understand that if the bills weren't cut, he would make it so hot for us we wouldn't need any gas."

"I was just looking at an article—" Evans started to say when the master mechanic interrupted: "To hell with the articles! We've got to do something about it!"

Evans doesn't often get angry, but Carter's attitude aroused his ire. "Well, if you'll tell me what to do, I'll do it!" he said sharply. "What I started to say is I was reading an article about gas burners for railroad use that might help solve our problem."

"Let's see it!" Carter picked up the magazine and glanced at the article. He started to lay the paper down, but a drawing showing a gas burner for starting fires in locomotives attracted his attention.

"If you don't mind, I'd like to look this over," he told Evans.

Burners used in the Plainville shops, except for the ones for heating stationary boilers, are home-made. They had been built with little regard to efficient opera-

tion. If a burner got the job done, it was O. K. regardless of gas consumption.

"What do you say we build a burner like this one for firing locomotives." Carter pointed to the illustration in the magazine. "It might use less gas than firing through the oil burner."

Firing through the oil burner mixes no air with the gas until after it is in the firebox. Air for combustion is drawn in by the blower. The burner shown had provisions for mixing air with the gas.

The burner when completed and tested proved more efficient two ways. Less gas was required to heat a locomotive and it was not necessary to use so much blower. This reduced the amount of steam required from the stationary which in turn reduced gas used there.

New burners of more efficient design were built for use in the pipe-fitter's furnace and for heating tires and rivets.

Two months later one of those rare epistles on a railroad, a letter commending Evans for the reduction in gas, came in the mail.

Carter was much relieved and pleased at the reduction. "We've made a better showing than I expected," he admitted.

"Yeah," Evans said dryly, "but we wouldn't if it hadn't been for that article."

"That reminds me," Carter replied. "My chief clerk tells me that you've been getting the copy of that paper that's supposed to come to my office. Hereafter, leave it until I get a chance to read it. If you want to be sure of getting it, maybe you'd better subscribe. I'm going to keep my copy."

Bench Miller for Cutting Piston Rings

In order to cut a section out of piston rings to give them the proper tension, the machine illustrated was developed.

Power miller for cutting ring gaps

This work was formerly done on a Brown & Sharpe milling machine, but so many times when the bench man wanted to cut the rings, the miller was in use. This necessitated waiting for the miller or using a hack saw and filing the ends.

With the bench miller the rings are given one cut and placed in stock. When the piston is to be fitted with rings, they are ordered from stock, marked off in the cylinder and placed in the machine. The saw is driven by a ½-hp. motor. The speed reducer is a worm and worm wheel fitted with anti-friction bearings. The unit is completely enclosed and lubricated by a pressure gun. A flexible coupling is placed between the motor and worm shaft.

The ⅛ in. by 5 in. saw makes 55 r.p.m. The ring is held in a vise the front part of which, when open, falls down on guide pins to allow the ring to be placed in and removed from the vise without any danger of coming in contact with the saw. The vise is attached by welding to a piece of steel tubing which slides in a cast-iron sleeve attached to the plate on which the motor and speed reducer is mounted. The vise with the ring clamped in it is elevated by a handle to engage the saw and make the cut.

As a further safety precaution, a switch is placed so that when the handle is raised to lower the vise, after the cut has been made, it automatically shuts off the power and the motor stops. Any amount of gap between the ring ends can be given without any filing. Provision is also made in the vise to allow any thickness or width of the ring to be cut.

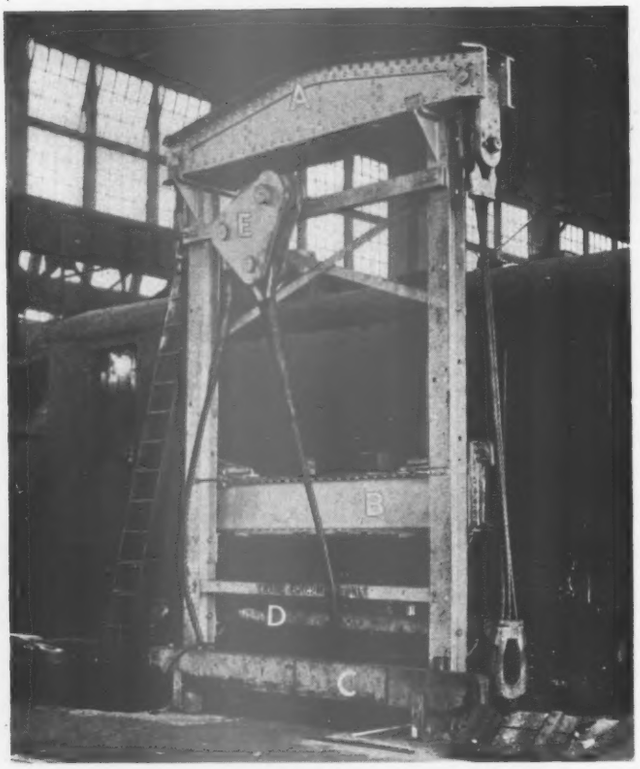
Crane Harness Sling Rack

A compact, efficient and safe rack for holding crane-harness sling equipment when not in use has been installed along with other shop improvements at the Sacramento, Cal., locomotive shops of the Western Pacific.

This rack consists of two 8-in. by 8-in. I-beams about 19 ft. long, spaced 10 ft. apart, and set 3 ft. deep in concrete blocks in the shop floor. A double-bar cross piece, made of 1-in. by 6-in. steel, and two diagonal cross braces, made of 3½-in. angles, serve to tie the vertical I-beams together near the top, 1¾-in. by 4¼-in. T-irons being provided near the bottom for the same purpose. The upper part of each vertical I-beam is equipped with a strong welded bracket, 6 in. wide by 22 in. long and having the outer ends turned up to support safely the heavy cross bar *A* of the crane-harness sling. For the heaviest locomotive lifts, bottom cross bar *B*, which is shown supported on suitable brackets on one side of the rack, is used, being placed under the rear of the locomotive and designed with a heavy hook on each end to engage the opening in the cable sling.

Bottom cross bars are also provided for lighter lifts, bar *C* being used for small locomotives and bar *D* for light equipment, such as ditchers, cranes, etc. The shackle *E*, with attached cable for lifting the front end of the locomotive, is clearly shown in the illustration, also its method of attachment to the rack. The shackle is supported on the two 1-in. by 6-in. cross bars at the angle shown, so that the large crane hook can be inserted and connected to the top pin without manual assistance.

This rack performs a double function in keeping this important crane equipment off the floor where it would take up valuable space and also be more or less detri-



Efficient and safe crane harness sling rack used at the Sacramento, Cal., locomotive shops of the Western Pacific

mental from a safety standpoint. It also supports the slings in such a way that they can be attached to the cranes with minimum delay and lost motion when needed for use.

Locomotive Boiler Questions and Answers

By George M. Davies

(This department is for the help of those who desire assistance on locomotive boiler problems. Inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless special permission is given to do so. Our readers in the boiler shop are invited to submit their problems for solution.)

Computing Tube Sheet Braces

Q.—I believe you should have Mr. Davies print a correction to the next to the last paragraph in the January "Locomotive Boiler Questions and Answers" from which I quote as follows: "The angle of each brace must be ascertained and, if in excess of 15 deg., the area of the brace must be reduced by multiplying the area of the brace by the cosine of the angle that the brace makes with a line drawn at right angles to the area supported."—J. T. P.

A.—In order to clarify the paragraph questioned, the following example is taken:

Assume that a boiler with 225 lb. working pressure has its tube sheet stayed with 1½-in. diameter unwelded brace rods, the area to be supported is so divided that each brace rod supports an area of 55 sq. in.

The stress on each brace rod would then be determined as follows: Cross-sectional area 1½-in. diameter brace rod = 1.7671 sq. in.

The load on each brace would be the boiler pressure multiplied by the area supported, or

$$55 \times 225 = 12{,}375 \text{ lb.}$$

The stress on each brace would be the load divided by the cross-sectional area of the brace rod, or

$$\frac{12{,}375}{1.7671} = 7003 \text{ lb. per. sq. in.}$$

This is the stress on each brace rod not considering the angle of the brace rod.

Assume that one brace rod was at an angle of 25 deg. with a line drawn at right angles to the tube sheet.

Then the effective cross-sectional area of the brace would be reduced by multiplying the area of the brace rod by the cosine of the angle, or

$1.7671 \times .90631 = 1.601$ sq. in. of effective cross-sectional area of 1½-in. brace rod at 25-deg angle.

The stress on the brace rod would then be

$$\frac{12{,}375}{1.601} = 7{,}729 \text{ lb. per sq. in., which would be the actual stress on this brace rod.}$$

Capacity of Locomotive Injector

Q.—Can you give an example of an improved method of figuring the capacity of a locomotive injector?—F. A. J.

A.—The William Sellers Company, Philadelphia, Pa., advises: "There are many factors to be considered in determining the capacity of live steam injectors, such as the temperature of the water in the tender, the height of lift or water head and finally the condition of the injector tubes, whether new or in a worn state.

"The best answer to the question would be to refer to the tables of tests of Sellers No. 10½ lifting injector at various steam pressures from 75 to 225 lb. and tank water temperature 65 deg.

"In the first table you will note that the injector delivers 10.7 lb. of water to a pound of steam at 200 lb. steam pressure. Knowing this, it is a simple matter to take the delivery temperature and, by referring to any standard steam table, arrive at a comparatively close answer to the capacity."

Performance of a No. 10-½ Sellers Self-Acting Injector—Lift, 2 Ft.

A—Maximum capacity					
Steam pressure, lb. per sq. in.	75	150	175	200	225
Gallons of water per hr.	2,757	3,719	3,940	4,068	4,068
Temperature of delivered water, deg. F.	128	149	156	164	174
Water fed, per lb. of steam used, lb.	17.2	12.8	11.8	10.7	9.7
B—Minimum Capacity					
Steam pressure, lb. per sq. in.	75	150	175	200	225
Gallons of water, per hr.	1,009	1,470	1,650	1,846	2,072
Temperature of delivered water, deg. F.	217	255	257	260	269
C—Range					
Steam pressure, lb. per sq. in.	75	150	175	200	225
Minimum capacity in per cent of maximum	36.6	39.5	42	45.3	49.1
Actual range in gallons per hr.	1,748	2,249	2,290	2,222	1,996
Range in per cent of maximum capacity	63.4	60.5	58	54.7	50.9
D—Limiting Temperature of Water Supply					
Steam pressure, lb. per sq. in.	75	150	175	200	225
Highest restarting temperature, deg. F.	128	118	110	104	96
Highest operating temperature, deg. F.	141	132	129	125	119
Highest operating temperature, Class K lifting or non-lifting injector, deg. F.	150	151	150	147	144

Method of Making Hollow Staybolt Iron

Q.—How is the hole put in the staybolt iron?—G. A. H.

A.—The hole is put in the staybolt iron by drilling or by some process of manufacture. One method of manufacturing hollow staybolt iron is as follows: A steel or iron pipe, full of sand is inserted in the center of a built-up fagot of steel or iron rods, as the case may be, heating the entire fagot to welding temperature and rolling. The elongation of the billet compresses and elongates the core of sand, which is subjected to pressure as well as heat. As a result, when the bar has reached the required diameter, which ranges ordinarily from $\frac{7}{8}$ in. to $1\frac{3}{16}$ in., the sand core has a diameter of about $\frac{3}{16}$ in. The sand has been very highly compressed and has become as fine as flour. This core is removed by compressed air.

Boiler Plate Embrittlement

Q.—What is boiler plate embrittlement and what causes it?—W. H. D.

A.—Boiler plate embrittlement is a term commonly applied to boiler metal that has failed due to the presence of too high a percentage of caustic soda in proportion to the other solids present in the boiler water.

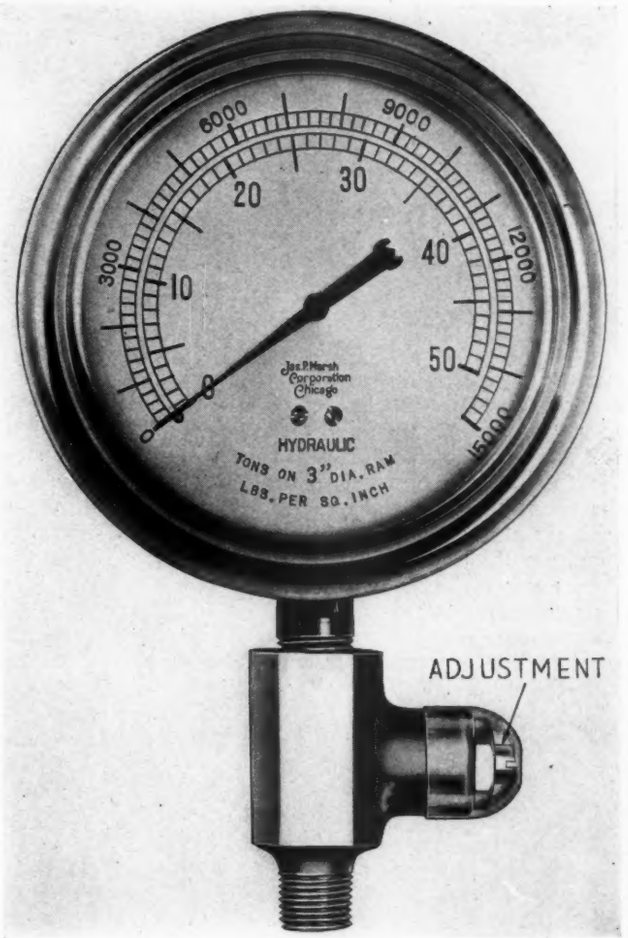
The theory of caustic embrittlement is that caustic soda in percentage of over 35 attacks boiler plate metal which is stressed beyond its yield point. Naturally, boiler waters seldom contain this percentage of caustic soda but boiler seams or the spaces around rivets may become filled with caustic soda and therefore become concentrated to this percentage. It is then in sufficient quantity to attack the metal and cause embrittlement. Actually the boiler metal does not become brittle but is given this term because the cracks caused appear to be due to the metal becoming brittle. Caustic soda evidently attacks the binder between the grains of iron and thereby weakens the structure of the plate.

The most common measure taken to prevent embrittlement is to obtain a proper ratio between the sodium sulphate and the alkalinity content of the boiler water. By increasing the sodium sulphate the percentage of caustic soda as compared to the rest of the solids in the boiler water is reduced, so that when concentrating in the boiler seams, etc., the percentage of caustic soda never becomes of sufficiently high percentage to cause embrittlement. The sodium sulphate seeps into the seams along with the caustic soda and its percentage is higher than the caustic soda. Consequently, the caustic soda percentage never reaches the 35 per cent necessary for embrittlement.

Pulsation Dampener For Gages

The illustrated pulsation dampener for gages, manufactured by the Jas. P. Marsh Corporation, Chicago, is constructed to protect pressure gages from the effects of excessive pulsation in pressure of fluids in hydraulic machinery. It functions to level off the peaks and valleys of oscillating pressure so that the indication hand, instead of vibrating wildly, stands absolutely still or just moves slowly back and forth over a very limited area, indicating the actual true pressure and eliminating the over-shooting and under-shooting which is the case where pressure pulsates rapidly.

This instrument is applicable to all types of hydraulic production equipment such as broaching machines, hydraulic-feed drilling machines, gear cutters, and hydraulic presses. It is also applicable to equipment operating on air pressure, gas pressure, or on vacua. It is made in two types: the external adjustable type, such as is illustrated, and the internal type which is built into the socket of the gage and which is not adjustable out in the field.



The Marsh pulsation dampener for hydraulic gages

Hydraulic Pipe Bending Machine

(*Continued from page 149*)

bends. The screw to move the nuts and spools is not visible in the picture and is operated from the far side of the machine.

While the nuts and spindle can be locked solidly in any position, the spools are always free to turn. Part of each spool is cut away to allow the pipe to be bent or kinked in any shape; one bend close to another, for example.

The operating valve is placed so that there is no danger of the operator being injured in case a pipe should break. Much time as well as a lot of hard work is saved by the machine and there is but little trouble with flat pipe if the dies are properly made and the spools properly spaced.

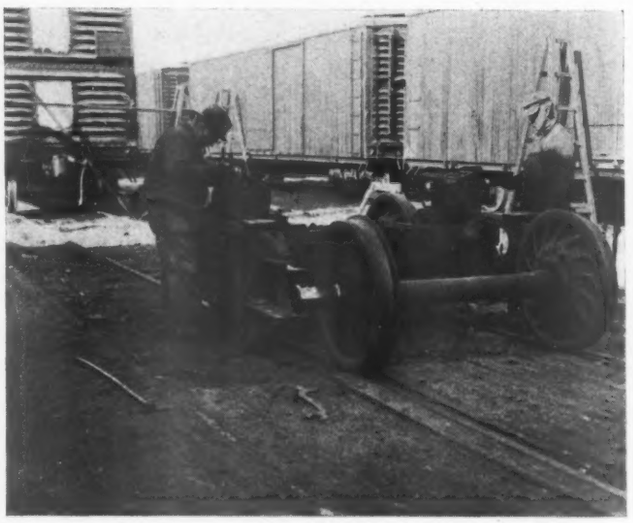
With the Car Foremen and Inspectors

Box Car Repairs With Small Working Force

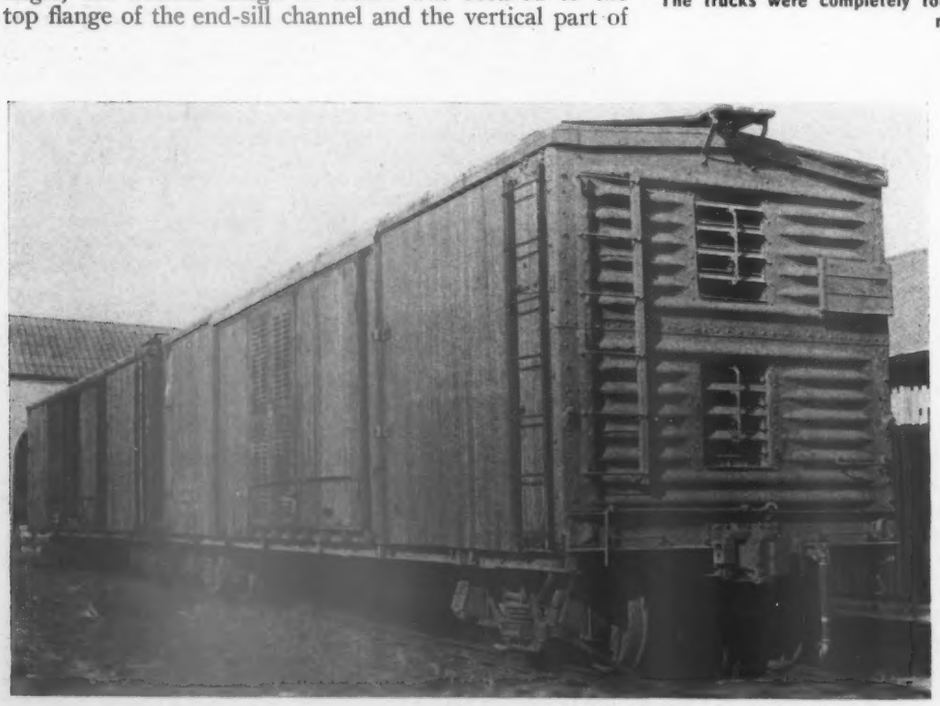
An interesting example of the ability of a small working force to make major repairs to cars is found in the rebuilding of a total of 75 ventilated box cars at the St. Augustine, Fla., shops of the Florida East Coast. These cars were repaired in lots of 25 at a time with a repair force of three car men and three helpers and the output was at the rate of four completed cars in a 22-day month.

After the cars had been placed on the repair tracks at the shops they were stripped down as the condition of each car necessitated. One of the illustrations shows the condition of a typical car after the stripping operation had been finished. The doors and end ventilators had been removed, the interior and exterior sheathing taken off and the old flooring torn up. Likewise, most of the insulation between the inner and outer sheathing was removed. As a rule the structural framing of the cars was found to be in fair condition, necessitating only the replacement of small quantities of corroded material at various locations. The side and center sills required only minor repairs, the heaviest work on these members being the splice-patching of the center sills at the draft-gear location on some of the cars.

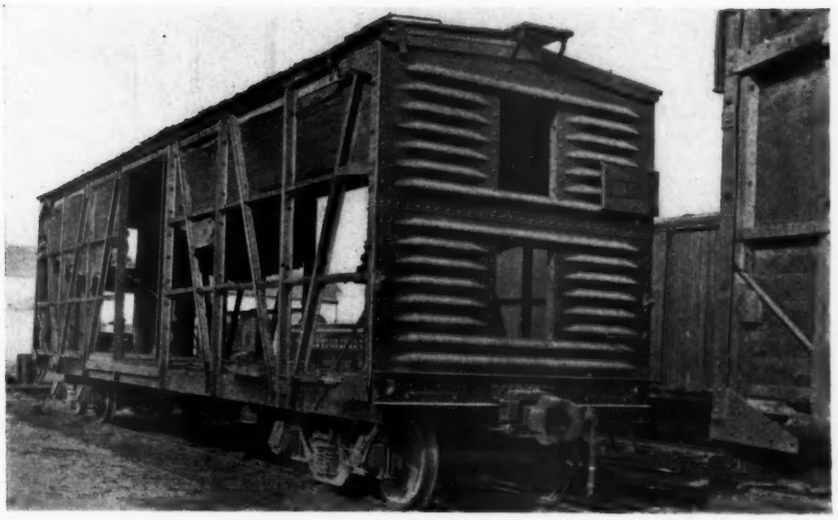
The steel car ends and end sills required somewhat heavier repairs. The car ends were found to be badly corroded just above the end-sill channels. This was repaired by the application of a patch over the entire width of the car. This steel patch was in the form of an angle, the bottom flange of which was secured to the top flange of the end-sill channel and the vertical part of the angle to the bottom of the car end, taking in about half of the lowest corrugation of the steel end. Three of the pictures show the condition of the end sill before repairs were made and after the application of a patch by two different methods—bolting and electric welding. Both methods were used, as circumstances dictated. Where the patch was bolted on it was secured to the end-sill channel by ⅜-in. rivets and to the car end by ⅜-in. Parker-Kalon patch bolts. The patch is made of No. 10-gage steel.



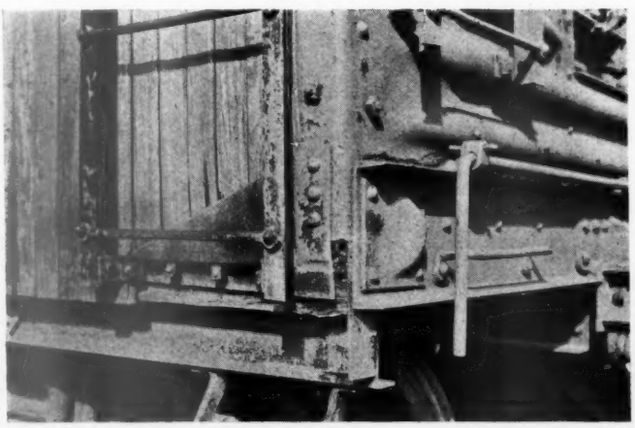
The trucks were completely torn down and all necessary worn parts renewed



Two of the ventilated box cars as they came to the shop for repairs. The ventilator type doors and the end ventilators were removed and replaced with solid doors and the ventilator openings closed up



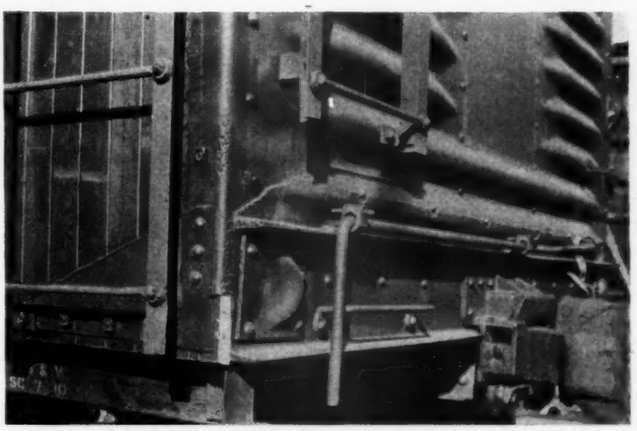
Here is one of the cars at the stage where the stripping has been completed. It is now ready for rebuilding



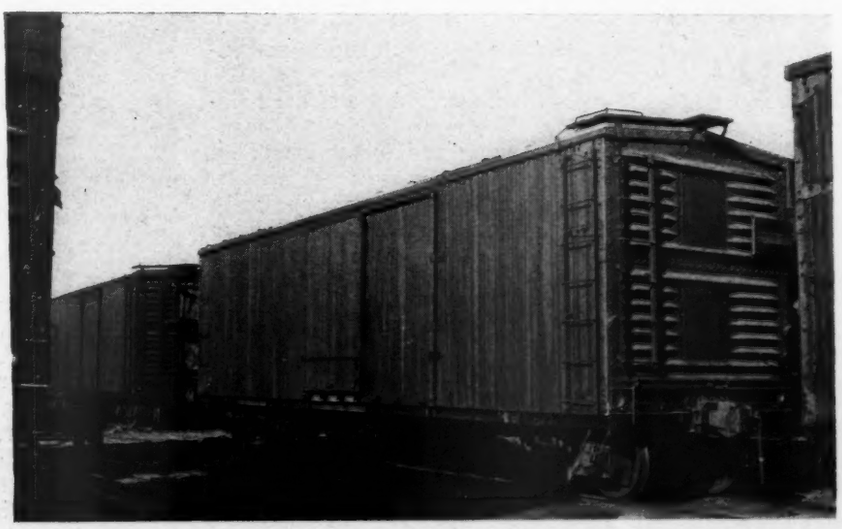
Severe corrosion had taken place at the car ends above the sills

Another job on the car ends was that of closing up the two openings in each end where the ventilators were removed. This was done by the application of No. 10-gage sheet inserts applied over the openings with ¼-in. Shakeproof slotted-head patch screws. The patch plate was drilled $\frac{5}{16}$ in. and the car end sheet drilled $\frac{7}{32}$ in. and tapped for the screws. These patch plates were applied with car cement at the joints.

The roofs on these cars were removed, repaired and replaced and new floors and end linings were applied. The sides and top linings were either completely replaced or repaired, depending on the condition of the individual car. The exterior sheathing was completely renewed and the ventilator doors, with which the cars were equipped, were removed and replaced with solid doors. The cinder guards at the front of the doors were replaced



Typical example of end and sill repairs by welding

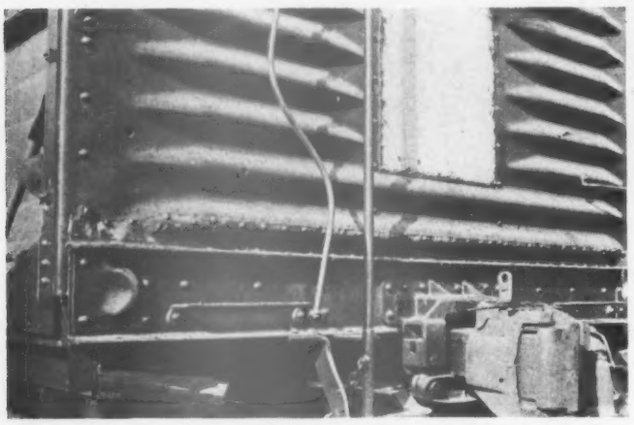


Two of the cars after the general rebuilding work had been completed and the cars made ready for the finish coats of paint

with an interlocking type guard which was made in the shop.

The draft gear with which the cars were equipped was removed and replaced with a Miner A22XB gear and, where couplers required replacing, the Type E coupler was substituted. The brake equipment was completely overhauled and all center plates, side bearings and draft lugs were tightened.

All of the trucks were removed and torn down. These trucks have cast-steel side frames with bolted truck



In this case the patch was applied with patch bolts. The closure of the end ventilators is seen above

boxes. The wheels are cast iron, 33 in. diameter, and the journals 5 in. by 9 in. New truck parts were applied, where necessary. Cracked side frames were welded. The trucks were reassembled with new dust guards, box bolts and journal brasses.

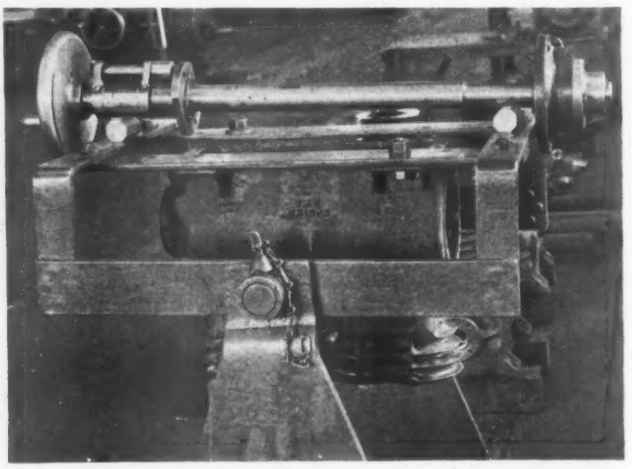
The completed cars were repainted with three coats of red paint on the body, two coats of car cement on the ends and a coat of red on the trucks. After stenciling and testing they were released for service.

Compressor Repair Stand and Boring Bar

Air-conditioning equipment has now been in service a sufficient length of time on many railroads so that compressors for the refrigerating media, such as Freon, for example, are in need of thorough overhauling, and the accompanying illustrations show two devices which greatly expedite this work at the Union Pacific passenger car shops at Omaha, Neb.

The particular compressors illustrated are of the Frigidaire type. These and other compressors are dismantled, ready for thorough cleaning and inspection of all parts, which are renewed where necessary and reassembled, using the special compressor repair stand shown in the illustrations. This stand consists of two triangular 5/8-in. steel sides, 32 in. high by 24 in. wide at the bottom, spaced 28 in. apart to accommodate the swinging compressor-support frame, and welded to suitable angles which are bolted to the shop floor. The revolving steel framework, which holds the compressor body in either an upright or inverted position by means of a locking pin through the trunnion and bushing connection shown, is 30 in. long by 24 in. wide and supports the base of the compressor 9 in. below the trunnion center. By this construction, it is obvious, therefore, that the compressor body can be readily held in either of two positions, or two elevations, dependent upon which is preferable for the most convenient handling of the various compressor repair operations.

Since a high degree of accuracy is necessary in repairing these compressors to make sure of satisfactory performance, special attention is paid to the crank shaft



Boring bar which is used in retruing the front main bearings of Frigidaire compressors

bearings which are refinished in accurate alinement by the use of the special boring bar shown on the floor in one illustration and on top of the compressor-support stand in the other. This boring bar is designed for use

Air-conditioning compressors receiving general repairs at the Union Pacific passenger car shops, Omaha, Neb.

in truing the front main bearing on Frigidaire compressors, which apparently is more subject to wear than the rear bearing. The bar itself is 38 in. long, made of $1\frac{15}{16}$-in. steel, reduced at one end to $1\frac{9}{16}$ in., where it accurately fits in a special bushing bolted to the bell-end of the compressor. At the seal-end of the compressor, another special bushing holds the boring bar in accurate alinement with the original bore of the bearings. The cutter, inserted in a slot in the bar at the main bearing,

is pin-connected so that when one end is pushed out by releasing one adjusting screw and tightening another, the cutter moves in, and vice versa. In other words, accurate screw adjustment of the 3/16-in. round-nose cutting tool, in and out as desired, is provided. Automatic feed of the cutter is secured by means of a ratchet operated by a dog on the shaft, shown in the illustration, a 9½-in. hand wheel being used to rotate the bar.

This type of boring bar has proved very satisfactory in refinishing the special metal crankshaft bearing in the seal end of the compressor. As many as 30 or 40 bearings may be finished with one grinding of the cutter.

Pneumatic Rack for Compressing Springs

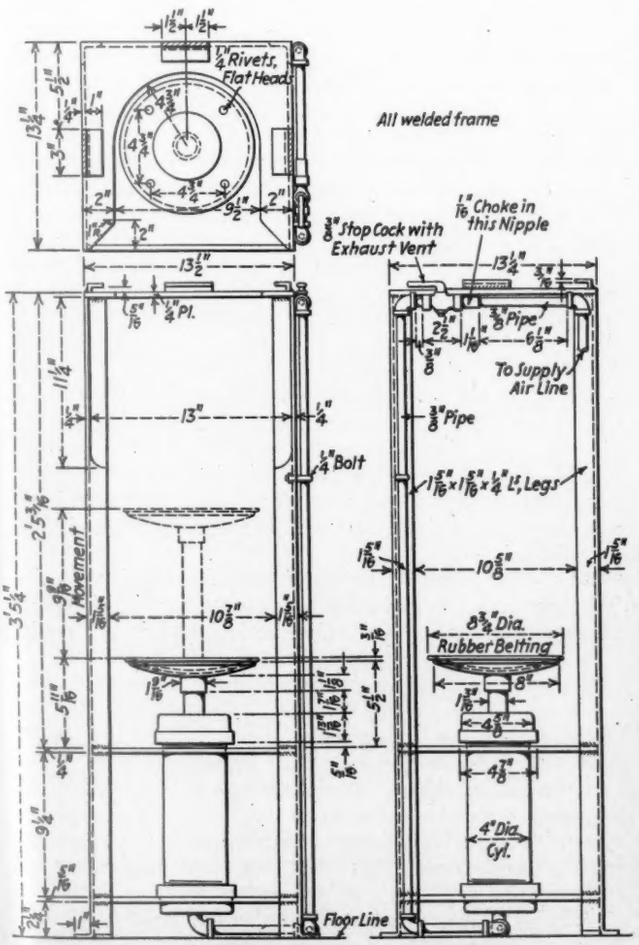
The drawing accompanying this article shows an ingenious design of a pneumatically actuated rack for compressing the spring in the non-pressure head of the AB brake-cylinder piston and non-pressure head assembly. This rack is designed to permit the ready removal of the holder ring and the gradual expansion of the return spring without danger of accident to the operator.

The complete rack is 3 ft. 5¼ in. in height and occupies a floor space of 13½ in. by 13¼ in. A small 4-in. cylinder is located in two spacer plates which are welded to the four corners of the rack. The upper end of the cylinder piston rod is provided with a cup-shaped pusher having an 8¾-in. diameter piece of rubber belting riveted to its top face so as to prevent damaging the piston packing cup on the piston head.

When disassembling the piston and non-pressure head assembly, the top face of the non-pressure head engages the under side of the top plate on the rack, this plate being slotted out to receive the tapered projection of the non-pressure head.

It will be noted that the two front angle irons are cut away 11¼ in. down from the top of the rack to permit the non-pressure head to be swung outward. The upper plate is punched at three points to form three angular clips which face inward and are spaced slightly above the upper deck plate and serve as retainers for the flange of the non-pressure head when the piston assembly is turned upside down for the replacement of packing cups or lubricators.

This device is one that is in use in the shops of the St. Louis-San Francisco.



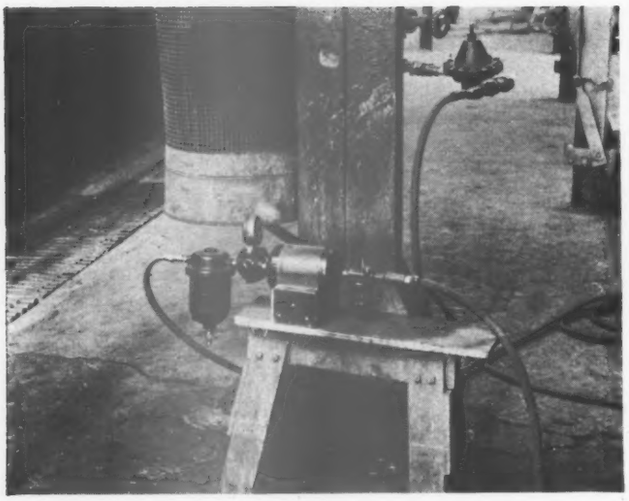
Detailed drawing of rack for compressing springs

Mechanical Sanding And Rubbing Machine

The illustrations show special equipment used on a western road in water-rubbing the exterior surfacer coat on a chair car. This equipment consists of a Sterling Speed-Bloc sander, or rubber, which is designed with an easy hand hold and convenient operating handle, and has one airhose connection to supply air for vibrating the abrasive rubbing pad, and a second hose connection to supply water necessary in the rubbing operation. The ½-in. hose lines are approximately 50 ft. long so as to reach easily from the center water-and-air supply post to either end of a car.

The necessary shut-off valve and pressure-reducing valve in the water line is shown in the upper part of the second illustration, the water pressure being reduced

Operation of water-rubbing the surfacer coat in a chair car exterior, using a Sterling Speed-Bloc rubber, or sander



Pressure reducing valves and other equipment used in air- and water-lines

from 45 lb. to about 15 lb. Special equipment used in the air line is mounted on a small wooden horse for convenient portability, as shown in the lower part of the same illustration. This equipment consists (left to right) of a water separator, pressure-reducing valve and gage, air strainer and lubricator. The air pressure is reduced from 90 lb. to about 60 lb., which has been shown to give best results with this type of mechanical-sanding machine. The lubricator supplies just enough oil to keep the rubber in good operating condition.

The application of a rubbing surfacer coat with the machine, illustrated, is said to give as good or a better job than would be possible with hand rubbing. It saves about 30 per cent of the manual labor in water-rubbing, or sanding, all flat surfaces.

In this connection, it is interesting to note that the general method of painting car exteriors followed on this road is to remove all paint by sandblasting or some equivalent method and then apply one priming coat, one putty coat, one coat of putty glaze, two surfacer coats and two color coats. The secret of the success of this method of finishing hinges upon the quality of the materials used and the care with which the initial coats are applied. If the putty and surfacer coats are given sufficient time to dry and not hurried too much, a foundation is secured which may be depended upon not to give subsequent trouble.

Among other problems, encountered on this as well as other roads, is the maintenance of satisfactory exterior painting conditions under the highly damaging effect of flying sand and gravel at modern high operating speeds. In some instances this action has been so severe as to cut the paint and actually wear holes in air brake pipe lines under the cars. Special materials, including rubberized paints, paints with an asphalt base, and sand-impregnated paints have been experimented with in an attempt to solve this problem, but so far without entire success.

Air Brake Questions and Answers

D-22-A Passenger Control Valve

410—*Q.—What are the functional characteristics of the brake as applied to passenger trains?* A.—This brake includes the proven desirable elements of its predecessor in this class of service with the addition of features that provide a brake of greater flexibility called for in high-speed operation of modern trains.

411—*Q.—How is a faster and more certain brake action provided?* A.—By features which produce improved functions as will be shown later.

412—*Q.—Is there any improvement in quick service?* A.—Yes. An operation is featured during initial service brake application to insure fast transmission with positive movement of the service slide valve to the application position regardless of service slide valve friction.

413—*Q.—How is the brake cylinder pressure development provided for?* A.—A limited positive and uniform development of brake cylinder pressure results on all cars with a minimum brake pipe reduction.

414—*Q.—How does this affect train slack?* A.—It permits the train slack to adjust promptly without harsh action.

415—*Q.—In what way is service release improved?* A.—Positive release is obtained regardless of service slide valve friction.

416—*Q.—What feature is responsible for this kind of a release?* A.—A release insuring feature which operates to release the brake positively when the brake pipe pressure exceeds the auxiliary reservoir pressure by 1½ lb.

417—*Q.—In what way is the graduated release improved?* A.—The operation of this feature is such that an exceedingly uniform and flexible brake cylinder pressure release is secured on all cars when graduating off the brake.

418—*Q.—Why is an improved emergency transmission speed as obtained with this equipment of great importance?* A.—This is important during emergency brake application due to the fact that a further improvement in control of slack action is accomplished as compared to old standard equipment.

419—*Q.—What improvement is obtained when releasing after an emergency brake application?* A.—A faster and more positive release is obtained by the use of an accelerated release feature.

420—*Q.—How is this accomplished?* A.—By connecting a volume known as the displacement reservoir in addition to the auxiliary reservoir to the brake pipe during initial release to increase brake pipe pressure locally.

421—*Q.—What effect does this have?* A.—Supplements air flow from the brake valve, providing a fast rise in brake pipe pressure.

422—*Q.—What other benefit is derived from this arrangement?* A.—Also provides a definite reduction of auxiliary reservoir pressure thus insuring a positive and prompt release.

423—*Q.—How is increased capacity obtained?* A.—The maximum brake cylinder volume for which the old passenger brake control valve is designed is the equivalent of two 16-in. cylinders. The D-22-A control valve is designed as a piloting device for the operation of one or more large capacity relay valves, therefore, one standard control valve may be used with any desired number, size or arrangement of brake cylinders.

424—*Q.—How are fast application and release rates obtained from high-speed service?* A.—The combination of control valve and relay valve provides exceedingly flexible control of the very fast application and release rates required for high-speed service.

425—*Q.—When mixed with other equipment what provision is made?* A.—The rates of application and release may be adjusted to correspond.

High Spots in

Railway Affairs . . .

Worth Pondering Over

A friend coming from a government office in Washington, recently found himself in a strange street. On a monument to Samuel Gompers in a small park he found this inscription: "No lasting gain has ever come from compulsion; if we seek to force, we but tear apart that which united is invincible. There is no way whereby our labor movement may be assured sustained progress in determining its policies and its plans other than sincere democratic deliberation until a unanimous decision is reached. This may seem a cumbrous, slow method to the impatient, but the impatient are more concerned for immediate triumph than for the education of constructive development."

Highways Being Abused

According to the findings of the research department of the Western Association of Railway Executives, the railways are losing traffic to highway motor trucks that, if carried by the railways, would produce additional annual revenue of nearly two billion dollars. At the meeting of the American Railway Engineering Association, C. E. Johnston, chairman of the Western Association of Railway Executives, said that a recent study in Illinois showed that the state incurred an annual cost of $1,361.28 for a heavy duty truck and collected from the same vehicle only $364.56 in all kinds of fees. Such payments, he insisted, are not taxes, but are merely inadequate contributions towards the enormous expense of providing special facilities (highways) for the special use of trucks. As a matter of fact, such highways, provided at public expense, were constructed primarily for use by passenger automobiles, for farm-to-market service, and the local distribution of goods.

Railroad Legislation

March proved to be a most confusing month, so far as progress toward constructive transportation legislation was concerned. The hearings on the Lea Omnibus Bill continued but the pressure by special interests was so great that the fate of the railroads, as well as the general public interest, seemed to be largely lost sight of. Chairman Lea early in the month introduced the Committee-of-Six Bill in the House, as well as one to place freight forwarders under I. C. C. regulation. The committee hearings included presentations by the waterway interests; a statement from the National Grange; testimony by the trustees of the Chicago Great Western in which, among other things, the policy of the Association of American Railroads was severely criticized; strong objections on the part of the Rock Island interests to features of the Committee-of-Six Bill, including the organization of a transportation board; objections by government traffic clerks to the repeal of the land grant rates; criticism by the trainmen of consolidation features of the Committee-of-Six Bill, etc., etc. Meanwhile the Interstate Commerce Commission gave Representative Lea a lengthy report expressing its opinion on various features of the different bills. "It is always darkest before dawn." reads an old adage. If that is true, then there certainly should be real hope for remedial railroad legislation, because it is hard to conceive of a more confused and complicated situation than that which unfolded itself at the hearings.

Stockholders' Meetings in Britain

Proceedings of the annual meetings of the British railways are always interesting. The shareholders' comments cover a wide range of topics. At the recent meeting of the London & North Eastern Railway Company, for instance, they ranged from the suggestion that a lady director be appointed, to a criticism of the cleanliness of locomotives. One shareholder commented on the fact that "a bright green, clean Pacific locomotive was a joy to the eye and an excellent advertisement to the company." If it is not possible to return to the pre-war standard of cleanliness of locomotives, he suggested that they be painted black to cover deficiencies. Sir Ronald W. Matthews, the chairman, in replying said that "if we economize, as we must economize at the present time, it must mean some deterioration in the condition of our stock." He hoped, however, that it would never be necessary to depart from the green and now the blue engines, which are such a feature of the railway.

If War Comes

Far too little consideration has been given to railway facilities in the discussions of national defense, according to Col. C. D. Young, vice-president of the Pennsylvania, in a recent address before the Ohio Valley Advisory Board in Columbus, Ohio. Colonel Young is chief of the railway section, office of chief of engineers, U. S. Army. He was commissioned a lieutenant-colonel of engineers while engaged in overseas operations during the World War. He advocates the adoption of the recommendations of the Committee-of-Six, if the carriers are to be better prepared for war emergencies. Comparing the equipment today with that of 1929, he believes that "if the railroads were suddenly faced today with a business equal to that of 1929 we might suffer congestion of major importance."

Railroad Wages in 1938

During 1938 employees engaged in maintenance of equipment work to the number of about 240,000, received an average wage of $1,666. This compares with $1,244 for those engaged in maintenance of way work; $1,947 for professional, clerical and general employees; $2,444 for engineers, firemen, conductors and brakemen; and $1,715 for other transportation service employees. The average earnings of all classes of railway employees in 1938 amounted to $1,859, the highest figure ever reached; this in spite of the fact that the average number of hours paid for was 2,481, a considerable decrease from 2,693 in the year 1920. The average hourly earnings, however, were 74.9 cents in 1938, as compared to 66.6 cents in 1929, and 67.6 cents in 1920.

1938 Capital Expenditures

The Association of American Railroads has announced that the capital expenditures for equipment and other improvements to railway property for Class 1 railroads in 1938 amounted to $226,937,000. This was less than half the expenditure for these purposes in 1937. Of special interest to those in the mechanical department is the fact that expenditures for locomotives in 1938 amounted to $39,570,000, as compared to $59,738,000 in the previous year. Freight train car expenditures amounted to $52,814,000, as compared to $212,902,000 in 1937. Only $18,149,000 was paid for passenger train cars in 1938, although $41,491,000 was expended for this purpose in the previous year. Depression years have caused a heavy falling off in capital expenditures by the Class 1 railroads, as indicated in the table above.

Capital Expenditures, 1929-1938, inclusive

1929	853,721,000
1930	872 608,000
1931	361,912,000
1932	167,194,000
1933	103,947,000
1934	212,712,000
1935	188,302,000
1936	298,991,000
1937	509,793,000
1938	226,937,000

Among the Clubs and Associations

CAR FOREMEN'S ASSOCIATION OF OMAHA, COUNCIL BLUFFS AND SOUTH OMAHA INTERCHANGE.—Meeting 1:30 p. m., April 13, Burlington Station, Omaha, Nebr. Speaker: C. B. Stemple. Subject: Rules 68 to 82.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.—Meeting 10 a. m., May 16, Ansley Hotel, Atlanta, Ga. Speaker: L. E. Caldwell, educational director, Electro-Motive Corp., La Grange, Ill. Subject: Diesel Motive Power.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Meeting April 10, La Salle Hotel, Chicago. Speaker: E. J. Hollahan, general car foreman, Illinois Central. Subject: Handling of Passenger Train Cars in Terminal Yards.

CAR DEPARTMENT ASSOCIATION OF ST. LOUIS.—Meeting 8 p. m., April 18, Hotel Mayfair, St. Louis, Mo., preceded by dinner at 6:15. Speaker: J. M. Patterson, general vice-president, Brotherhood Railway Carmen of America. Topic: Vocational Education of Carmen.

NORTHWEST CAR MEN'S ASSOCIATION.—Meeting 8 p. m., April 3, Midway Club, 1931 University avenue, St. Paul, Minn. Speaker: W. J. Patterson, director, Bureau of Safety, Interstate Commerce Commission. Subject: "The Relation of Car Construction and Maintenance to Safety."

NEW ENGLAND RAILROAD CLUB.—Meeting 6:30 p. m., April 11, Hotel Touraine, Boston, Mass. Speaker: R. F. Harrington, foundry superintendent and chief metallurgist, Hunt-Spiller Mfg. Corp. Subject: "Cast-Iron—From Coast Defense Guns to Modern Locomotive and Industrial Castings," with lantern-slide illustrations.

Club Papers

Steam-Electric Locomotive Discussed at N. Y. Railroad Club

New York Railroad Club.—The 5,000-hp. steam-turbo-electric locomotive recently built for the Union Pacific by the General Electric Company, was the chief topic of discussion at the meeting of the New York Railroad Club on March 24. Some 500 railroad and supply-trade men heard H. L. Andrews, vice-president of General Electric, describe the 530,000-lb. giant, after which the speaker answered the questions fired at him in rapid succession from the floor. ¶ During this period it was brought out, among other things, that the locomotive has been in revenue passenger service on the New York Central between Buffalo, N. Y., and Cleveland, Ohio, as a preliminary to regular operation on the Union Pacific; that adequate comparison between the new locomotive and conventional steam and Diesel-electric power cannot be drawn until the steam-electric has been in service under more trying conditions on heavy U. P. trains; and that General Electric may possibly design a pulverized coal-burner of a similar type. A motion picture reel with sound and a series of slides supplemented the discussion. ¶ The entertainment feature of the program consisted of a play entitled "Achmed and His Three Sons," done in an Arabian atmosphere complete with elaborate settings and costumes with incidental music and a cast consisting of employees of the General Electric. In brief the drama was designed to show what happens when the sales, production or design departments of an industrial concern fail to appreciate the need for one another.

DIRECTORY

The following list gives names of secretaries, dates of next regular meetings, and places of meetings of mechanical associations and railroad clubs:

AIR-BRAKE ASSOCIATION.—R. P. Ives, Westinghouse Air Brake Company, 3400 Empire State building, New York.

ALLIED RAILWAY SUPPLY ASSOCIATION.—J. F. Gettrust, P. O. Box 5522, Chicago.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—G. G. Macina, 11402 Calumet avenue, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—C. E. Davies, 29 West Thirty-ninth street, New York.

RAILROAD DIVISION.—Marion B. Richardson, P. O. Box 205, Livingston, N. J.

MACHINE SHOP PRACTICE DIVISION.—Erik Aberg, editor, Machinery, 148 Lafayette St., New York.

MATERIALS HANDLING DIVISION.—F. J. Shepard, Jr., Lewis-Shepard Co., Watertown Station, Boston, Mass.

OIL AND GAS POWER DIVISION.—M. J. Reed, 2 West Forty-fifth street, New York.

FUELS DIVISION.—A. R. Mumford, Consolidated Edison Co., 4 Irving Place, New York.

ASSOCIATION OF AMERICAN RAILROADS.—J. M. Symes, vice-president operations and maintenance department, Transportation Building, Washington, D. C.

OPERATING SECTION.—J. C. Caviston, 30 Vesey street, New York.

MECHANICAL DIVISION.—V. R. Hawthorne, 59 East Van Buren street, Chicago. Annual meeting June 28, 29 and 30, at the Commodore Hotel, New York.

PURCHASES AND STORES DIVISION.—W. J. Farrell, 30 Vesey street, New York. Convention of entire membership June 14-15, Palmer House, Chicago.

MOTOR TRANSPORT DIVISION.—George M. Campbell, Transportation Building, Washington, D. C.

CANADIAN RAILWAY CLUB.—C. R. Crook, 4468 Oxford avenue, Montreal, Que. Regular meetings, second Monday of each month, except June, July and August, at Windsor Hotel, Montreal Que.

CAR DEPARTMENT ASSOCIATION OF ST. LOUIS.—J. J. Sheehan 1101 Missouri Pacific Bldg., St. Louis, Mo. Regular monthly meetings third Tuesday of each month, except June, July and August, Hotel Mayfair, St. Louis, Mo.

CAR DEPARTMENT OFFICERS' ASSOCIATION.—Frank Kartheiser, chief clerk, Mechanical Dept., C. B. & Q., Chicago.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—G. K. Oliver, 2514 West Fifty-fifth street, Chicago. Regular meetings, second Monday in each month, except June, July and August, La Salle Hotel Chicago.

CAR FOREMEN'S ASSOCIATION OF OMAHA, COUNCIL BLUFFS AND SOUTH OMAHA INTERCHANGE.—H. E. Moran, Chicago Great Western, Council Bluffs, Ia. Regular meetings, second Thursday of each month at 1:15 p. m.

CENTRAL RAILWAY CLUB OF BUFFALO.—Mrs. M. D. Reed, Room 1817, Hotel Statler, Buffalo, N. Y. Regular meetings, second Thursday each month, except June, July and August, at Hotel Statler, Buffalo.

EASTERN CAR FOREMAN'S ASSOCIATION.—Roy MacLeod, Room 127, G. O. Bldg., N. Y., N. H. & H., New Haven, Conn. Regular meetings, second Friday of each month, except May, June, July, August and September.

INDIANAPOLIS CAR INSPECTION ASSOCIATION.—R. A. Singleton, 822 Big Four Building, Indianapolis, Ind. Regular meetings, first Monday of each month, except July, August and September, at Hotel Severin, Indianapolis, at 7 p. m.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—See Railway Fuel and Traveling Engineers' Association.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—F. T. James, general foreman D. L. & W., Kingsland, N. J.

INTERNATIONAL RAILWAY MASTER BLACKSMITHS' ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark avenue, Detroit, Mich.

MASTER BOILER MAKERS' ASSOCIATION.—A. F. Stiglmeier, secretary, 29 Parkwood street, Albany, N. Y.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic avenue, Boston, Mass. Regular meetings, second Tuesday in each month, except June, July, August and September, at Hotel Touraine, Boston.

NEW YORK RAILROAD CLUB.—D. W. Pye, Room 527, 30 Church street, New York. Meetings, third Friday in each month, except June, July, August, September, at 29 West Thirty-ninth street, New York.

NORTHWEST CAR MEN'S ASSOCIATION.—E. N. Myers, chief interchange inspector, Minnesota Transfer Railway, St. Paul, Minn. Meetings, first Monday each month, except June, July and August, at Midway Club rooms, University and Prior avenue, St. Paul.

PACIFIC RAILWAY CLUB.—William S. Wollner, P. O. Box 3275, San Francisco, Cal. Regular meetings, second Thursday of each month in San Francisco and Oakland, Calif., alternately, excepting June in Los Angeles and October in Sacramento.

RAILWAY CLUB OF GREENVILLE.—Sterle H. Nottingham, Greenville, Pa. Regular meetings, third Thursday in month, except June, July and August.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 1941 Oliver Building, Pittsburgh, Pa. Regular meetings, fourth Thursday in month, except June, July and August, Fort Pitt Hotel, Pittsburgh, Pa.

RAILWAY FIRE PROTECTION ASSOCIATION.—P. A. Bissell, 40 Broad street, Boston, Mass.

RAILWAY FUEL AND TRAVELING ENGINEERS' ASSOCIATION.—T. Duff Smith, 1255 Old Colony building, Chicago.

RAILWAY SUPPLY MANUFACTURERS' ASSOCIATION.—J. D. Conway, 1941 Oliver Building, Pittsburgh, Pa. Meets with Mechanical Division and Purchases and Stores Division, Association of American Railroads.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.—A. T. Miller, P. O. Box 1205, Atlanta, Ga. Regular meetings, third Thursday in January, March, May, July and September. Annual meeting, third Thursday in November, Ansley Hotel, Atlanta, Ga.

TORONTO RAILWAY CLUB.—D. M. George, Box 8, Terminal A, Toronto, Ont. Meetings, fourth Monday of each month, except June, July and August, at Royal York Hotel, Toronto, Ont.

TRAVELING ENGINEERS' ASSOCIATION.—See Railway Fuel and Traveling Engineers' Association.

WESTERN RAILWAY CLUB.—W. L. Fox, executive secretary, Room 822, 310 South Michigan avenue, Chicago. Regular meetings, third Monday in each month, except June, July, August and September.

(*Turn to next left-hand page*)

Chilled Car Wheels have always possessed characteristics not found in wheels made from other materials. Today these wheels are better, stronger, and more uniform than ever before. This is owing in part to important metallurgical and design improvements, in part to a Centralized Inspection Service, and in important part to modernized facilities which produce under more accurately controlled conditions.

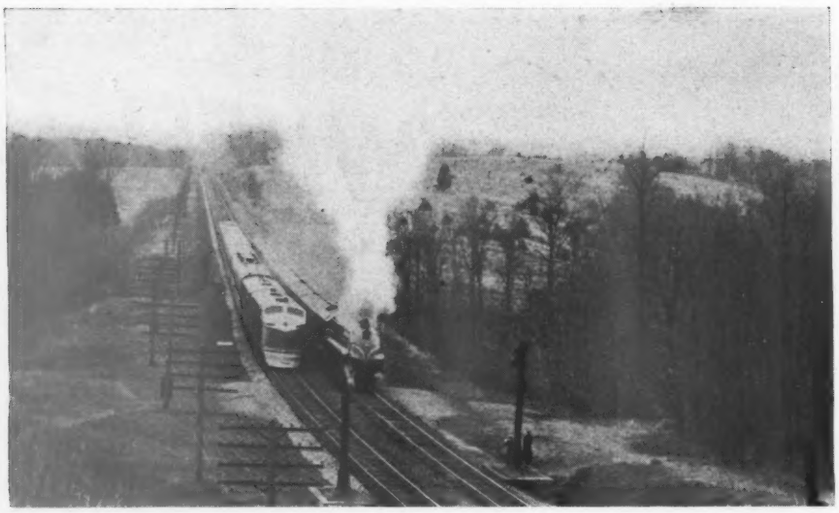
ASSOCIATION OF MANUFACTURERS OF CHILLED CAR WHEELS

230 PARK AVENUE,
NEW YORK, N.Y.

445 N. SACRAMENTO BLVD.,
CHICAGO, ILL.

AMCCW

ORGANIZED TO ACHIEVE:
Uniform Specifications
Uniform Inspection
Uniform Product



The London, Midland & Scottish "Coronation Scot" running beside the Diesel-electric "Capitol Limited" of the Baltimore & Ohio near Waring, Md. The English train will be on exhibit at the New York World's Fair after the completion of its tour through eastern United States

NEWS

Enginehouse Construction

The Pennsylvania has awarded a contract to W. F. Trimble & Sons Company, Pittsburgh, Pa., for the construction of an enginehouse at Oil City, Pa.

The Missouri Pacific has awarded a contract to J. S. Alberici, St. Louis, Mo., for the construction of a 20-ft. extension of five enginehouse stalls in the Ewing Avenue enginehouse, St. Louis, Mo. The new stalls will be 120 ft. long. This work is part of an $80,000 improvement program at this point which will include also the paving of the floors with concrete in 15 stalls, the installation of 15 heating units for thawing out the underside of locomotives and the construction of a tool room to serve both the enginehouse and the machine shop. A portion of the work will be done by company forces.

Record in Average Freight-Train Speed Set Up in 1938

A NEW high record in the average speed of freight trains was established by the railroads of the United States in 1938, J. J. Pelley, president of the Association of American Railroads, announced on February 27. This average speed, according to reports for the year which have just become available, was 61 per cent higher than in 1920.

In 1938, the average distance traveled per train per day was 398 miles, compared with 386 miles in 1937 and 247 miles in 1920. This represents the average time required for the movement of all freight trains between terminals, including all delays en route.

"Because of improvements in locomotive and freight car construction," the statement points out, "the number of delays due to mechanical failures has been reduced. Use of locomotive tenders with a greater fuel and water capacity has reduced the number of stops for supplies en route. Length of locomotive runs has been increased. In addition, improvements in roadway, signals, and methods of operation have further expedited the movement of loaded freight cars through terminals and over the road."

Insulating Materials Being Tested at Purdue

THE answers to questions regarding the relative efficiency and effective service life of various insulating materials used in railway equipment are being sought by the Purdue University Engineering Experiment Station in an extensive series of tests being conducted by Prof. W. T. Miller and T. K. Sanders of the Purdue Engineering Experiment Station staff, and M. M. McClure, representing the Gustin-Bacon Manufacturing Company, Kansas City, Mo. The tests are being made in co-operation with the Owens-Corning Fiberglas Corporation, and the Gustin-Bacon Manufacturing Company, and are designed to develop both the mechanical and chemical properties of 38 insulating products under observation.

In developing a method of testing, the Purdue engineers have worked out an eight-hour schedule, which reproduces in that period the conditions that an average car would experience in about 30 days of use on a railroad and, as a result, the insulating materials being tested already have been given the same wear that they would receive in 74 years of actual service. The tests have been under way approximately two years, during which period some of the materials have fallen by the wayside while others have shown that they will stand up under the severe conditions imposed on them.

As one of the steps in the testing, there was designed and built a "weathering room," 8 ft. by 8 ft. by 10 ft. In this room, the samples of insulations are subjected to repeated cycles of high humidity and drying which resemble all the conditions they would get in actual service applications in railway passenger and refrigerator cars. The samples under test rest in wire trays, half of them stationary and the other half subject to a vibration which resembles the most severe condition found in railway equipment.

In another room, known as the "hot box," a complete panel from the side wall of a refrigerator car has been set in, enabling the different materials to be tested for their insulation value, moisture absorption, drying characteristics and durability. There is a complete refrigerating unit in another room, as well as two of the largest electric hot plates ever used for determining thermal conductivities, each 30 in. square, to aid in the complete studies being made by this laboratory.

At regular intervals, samples of the various insulation are analyzed chemically and physically to detect any changes in insulating properties. Automatic switches control the testing processes but results must be checked regularly.

Equipment Building in Railroad Shops

The Chicago, Milwaukee, St. Paul & Pacific during 1939 will build in its shops at Milwaukee, 1,000 50-ton all-steel box cars and 75 steel caboose cars. Six Diesel-electric switching locomotives costing

(*Continued on next left-hand page*)

METHODS AND MACHINERY THAT GUARD LIMA QUALITY

Heat-Treatment Gives Life to Steel

Alloy steels play an ever-increasing part in the modern locomotive.

But only when properly heat-treated can they develop their unusual characteristics of strength and toughness.

At Lima modern furnace equipment provides uniform heating of the part to be treated while pyrometric control insures the precise temperature needed for heat-treating any analysis of steel.

Lima's heat-treating facilities bring out the best in alloy steels.

LIMA LOCOMOTIVE WORKS LIMA LOCOMOTIVE WORKS INCORPORATED INCORPORATED, LIMA, OHIO

in excess of $400,000 will be acquired under a lease purchase plan. These expenditures and other improvements were incorrectly credited to the Illinois Central on page 123 of the March issue of the *Railway Mechanical Engineer*.

The Canadian National will build in its own shops at Transcona, Man., 50 refrigerator cars to have steel underframes, steel superstructures and are to be steel plated. The company will also build 10 caboose cars in its shops at Moncton, N. B., and 15 caboose cars at London, Ont.

Locomotives for Exhibit at New York World's Fair

American Railroads.—The new four-cylinder passenger locomotive, the exhibit of the eastern railways, arrived at the New York World's Fair on March 13 on the tracks of the Long Island and is now installed on its foundation there.

The new locomotive and tender together extend 140 ft. in length and weigh 526 tons. The locomotive, which is non-articulated, has a 6-4-4-6 wheel arrangement and develops 6,500 hp. at 100 m.p.h. Its tender rests upon two 8-wheel trucks and has capacity for 24,500 gal. of water and 25 tons of coal. The locomotive has a tractive force of 76,400 lb.; a boiler surface of 7,748 sq. ft., and operates at a steam pressure of 300 lb. per sq. in. In general style, it is similar to the streamlined "Pacific" type K-4 class passenger locomotive now in operation on the Pennsylvania.

The locomotive was built at the Pennsylvania's Altoona (Pa.) shops and is designed for operation on that road. For the duration of the fair however, it will bear on its tender the signature "American Railroads," and is the exhibit of the World's Fair Committee of the Eastern Presidents' Conference.

Electro-Motive Corporation.—Six days of straining, tugging and delicate engineering were required to haul a two-unit Electro-Motive Diesel-electric locomotive weighing 560,000 lb. a distance of about five city blocks over the "made" ground of the New York World's Fair site between the unloading tracks of the Long Island and a square in front of the General Motors exhibit building where the locomotive is to be displayed. The two units of the locomotive are similar to "A" and "B" units, respectively, of a 6,000-hp., three-unit locomotive placed in service by the Seaboard Air Line in December, 1938. Each unit develops 2,000 hp. from two 1,000-hp. Diesel-electric power plants, as do those of the S. A. L. locomotives, and weight and size characteristics are substantially the same.

Great Northern.—One of America's historic locomotives, the "William Crooks," built at Paterson, N. J., in 1861, and now owned by the Great Northern, has traveled

(*Continued on next left-hand page*)

New Equipment Orders and Inquiries Announced Since the Closing of the March Issue

Locomotive Orders

Company	No. of Locos.	Type of Loco.	Builder
C. M. St. P. & P.[1]	2	1,000-hp. Diesel-electric	Electro-Motive Corp.
	2	600-hp.	Electro-Motive Corp.
	2	600-hp.	American Loco. Co.
C. R. I. & P.	11	20-gal. tenders	American Loco. Co.

Locomotive Inquiries

U. S. Navy Dept.	4	Oil-burner	
	1	Fireless	
	1	Gas-electric	
	14	40 to 60-ton Diesel electric	
Wabash	4	600-hp. Diesel-electric	

Freight-Car Orders

Road	No. of Cars	Type of Car	Builder
Canadian National	725	40-ton box	National Steel Car Co.
	650	40-ton box	Canadian Car & Fdry. Co.,Ltd.
	625	40-ton box	Eastern Car Co., Ltd.
John Morrell & Co.	100	Refrigerator	General American Trans. Co.
Lehigh & New England	100	50-ton hopper	Bethlehem Steel Co.
Lehigh Valley	500	50-ton hopper	Bethlehem Steel Co.
St. Louis Southwestern	100	Underframes for ballast cars	American Car & Foundry Co.
	100	Underframes for flat cars	American Car & Foundry Co.
Union Pacific	300	50-ton flat	Company Shops
	1,500	Underframes	Mt. Vernon Car Mfg. Co.
	500	Underframes	Pacific Car & Fdry. Co.

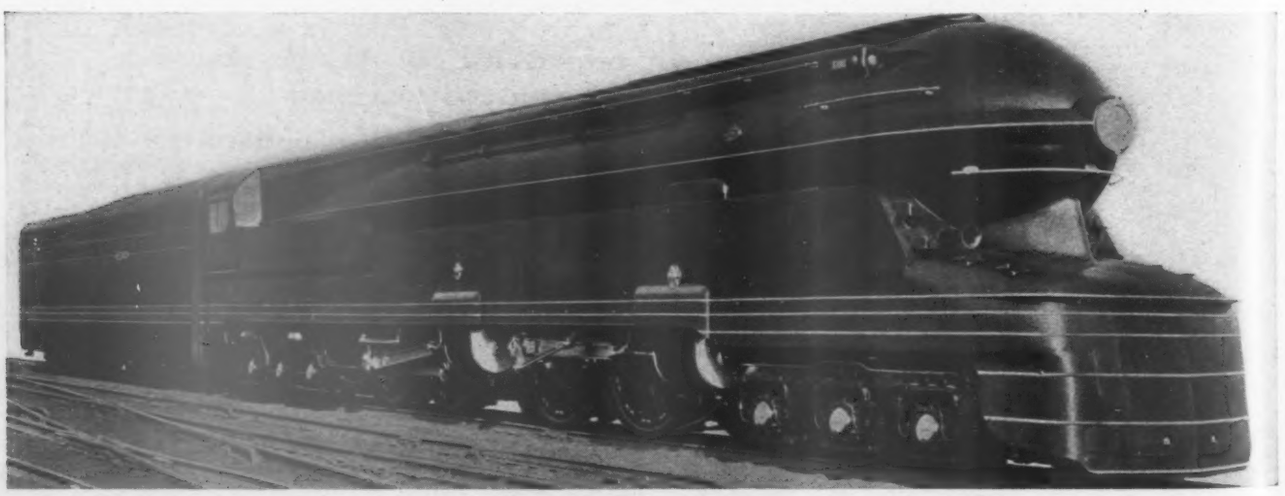
Freight-Car Inquiries

Denver & Rio Grande Western	250	50-ton automobile	
	250	50-ton box	
	100	70-ton gondola	
	100	Underframes for 40-ton stock cars	
Maine Central	150	50-ton gondola	
	150	40-ton gondola	
Swift & Company	2	40-ton tank	
Wabash	35	Caboose	

Passenger-Car Orders

Road	No. of Cars	Type of Car	Builder
Canadian National	5	Mail and express	Canadian Car & Fdry. Co.,Ltd.
	10	Baggage	Canadian Car & Fdry. Co.,Ltd.
C. R. I. & P.	2	Rocket trains	See Note[2]
Delaware & Hudson	6	Coaches	American Car & Foundry Co.
Lehigh Valley	10	Coaches	Pullman-Std. Car Mfg. Co.
Southern Pacific[3]	2	14-car trains	Pullman-Std. Car Mfg. Co.

[1] Lease-purchase contracts subject to the approval of the court.
[2] The two streamlined Rocket trains will cost $1,200,000. While formal contracts have not yet been signed, the ten lightweight coaches for these trains, dining cars and head end cars will be built by the Edward G. Budd Manufacturing Company; the six Pullman sleeping cars, including the Pullman observation car, will be built by the Pullman-Standard Car Manufacturing Company; and the two Diesel-electric locomotives will be built by the Electro-Motive Corporation.
[3] The trains will have the same basic design as the present Daylights and will be placed in operation between San Francisco and Los Angeles, Calif., late this year. They will be powered by 5,000-hp. steam locomotives.

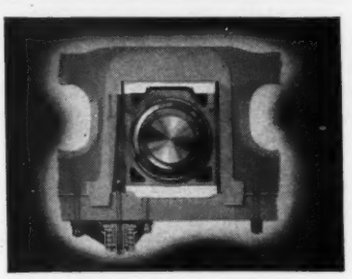


This giant four-cylinder passenger locomotive carries six-wheel leading and trailer trucks and a 16-wheel tender. It has been placed for exhibit at the New York World's Fair by the World's Fair Committee of the Eastern Presidents' Conference Committee. It was built at the Altoona, Pa., shops of the Pennsylvania for operation on that road.

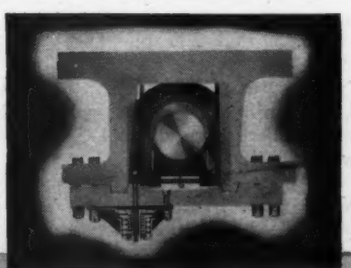
REDUCE MAINTENANCE...

modernize your driving boxes

Pounding driving boxes cause unnecessary expense . . . prevent it . . . by converting your driving box wedges into Franklin Automatic Compensators and Snubbers. » » » The bronze parallel-sided floating plate eliminates the air gap. The heavy outer spring acts as a cushion to take care of abnormal shocks. These insure lower maintenance, easier riding, and increased availability for service on both plain and roller bearing applications. » » » Take advantage of engineering improvements . . . bring your driving box wedges up-to-date . . . convert them into Franklin Automatic Compensators and Snubbers.



ABOVE: Franklin Automatic Compensator and Snubber for Roller Bearing Driving Box application. *BELOW:* Franklin Automatic Compensator and Snubber for Friction Bearing Driving Box application.



Because material and tolerances are just right for the job, genuine Franklin repair parts give maximum service life.

FRANKLIN RAILWAY SUPPLY COMPANY, INC.

NEW YORK CHICAGO MONTREAL

under its own power from St. Paul, Minn., to New York, where it is to be part of the exhibition, Railroads on Parade, at the New York World's Fair. The locomotive, pulling two ancient coaches, left St. Paul on March 14.

Boston & Maine.—Locomotive No. 905 of the Boston & Maine is being reconditioned at Somerville, Mass., and Billerica, for exhibition at the New York World's Fair. Members of the Railroad Enthusiasts Inc., New England Division, are attempting to make it look as it did in 1892 when it was built at the old Manchester (N. H.) Locomotive Works. Thus the locomotive will bear its original No. 494, an old style headlight, and a wooden pilot and cab, and both engine and tender will be gayly painted.

15-Ton Exhibit Shows How Locomotives Operate

A 15-TON exhibit to demonstrate how a railroad locomotive operates is being prepared for the Museum of Science and Industry, Chicago, by the Chicago & Eastern Illinois at its shops in Danville, Ill. The exhibit consists of a portion of the right side of a passenger locomotive. It includes the pilot, the side frame, the valve chamber, a cylinder, a main rod, a side rod, two driving wheels, and the connecting mechanism. It will be mounted and balanced so that all working parts will be driven by a small motor, while lights will show the movement of steam into the valve chamber and then into the cylinder, which has been cut away to show the piston and connecting rod.

R. R. Equipment to Be Discussed at Automotive Congress

SEVERAL papers of interest to railroaders will be presented at the 1939 World Automotive Engineering Congress of the Society of Automotive Engineers, Inc., which will be held at various points throughout the United States from May 22 to June 8, inclusive. According to the tentative program, two papers of particular application to the railroad field will be presented at the truck, bus and rail car session on May 25 in the Hotel Pennsylvania, New York. Col. E. J. W. Ragsdale of the Edward G. Budd Manufacturing Company will present "Engineering Problems Involved in the Use of Ferrous Metals to Reduce Weight," and Frank Jardine of the Aluminum Company of America will read a paper entitled "Engineering Problems Involved in the Use of Non-Ferrous Metals to Reduce Weight."

On May 26, at the same headquarters, a session on the Diesel engine will be held under the chairmanship of F. G. Shoemaker, Detroit Diesel Engine division, General Motors Corporation, at which time G. L. Neely of the Standard Oil Company of California will read a paper "Recent Developments in Diesel refracting oils." On June 7 at the Hotel Fairmont, San Francisco, Cal., an afternoon session on the Diesel engine will be held under the chairmanship of Mr. Shoemaker, wherein the application of the Diesel engine to railroad transportation will be presented by A. R. Walker, electrical equipment engineer, Illinois Central, Chicago.

N. Y. Central Prepares Rolling-Stock for World's Fair Business

FOR handling heavy passenger traffic for the New York World's Fair, the New York Central will soon put into operation 50 reconditioned coaches and 31 diners, all of which have been newly air-conditioned and improved. Twenty-five of the coaches have been completely redecorated in shades of gray and yellow, with blue upholstery, or tan and ivory with brown upholstery. The floors have been insulated against noise and a new lighting system installed. The 25 other coaches have been redecorated in shades of gray with blue-green upholstered seats and green-striped window curtains. By the air-conditioning of these cars and diners the New York Central's air-conditioned fleet will be brought to a total of 1046.

In addition the road has under construction 40 new light-weight Pullman cars of the type recently installed on the "Twentieth Century Limited" and 11 coaches of the type in service on the "Mercury." These are expected to be in service also for fair travel.

Stoker Order Postponed

THE Interstate Commerce Commission has further postponed the effective date of its order in the automatic stoker case to April 15. The commission's order in this case was upheld by a three-judge federal court at Cleveland, Ohio, on February 28, when it ordered railroads to install automatic stokers on all modern coal-burning locomotives. The order specified that 20 per cent of the locomotives be equipped with automatic stokers each year for five years, beginning July 1, 1938. Approximately 180 railroads had sued to enjoin the Interstate Commerce Commission from enforcing its order of December 27, 1937, contending that the installations would cost $39,003,000 or more. The order applies to practically all locomotives used on main lines. Railroad attorneys are studying the decision and it is quite possible that an appeal will be taken to the Supreme Court.

20 Pullmans at 84 M. P. H.

THE results of a recent test run of the Atlantic Coast Line's steam locomotive No. 1800 between Jacksonville, Fla., and Richmond, Va., are reported in the latest issue of "Baldwin Locomotives," quarterly publication of the Baldwin Locomotive Works. Herein it is revealed that the locomotive, one of 12 Class R-1, 4-8-4 type built by Baldwin, hauled the road's 20-car "Havana Special" along a five-mile stretch at an average speed of 84 m.p.h. At another point the locomotive performed a sprint of 13 miles in length at 73.6 m.p.h. In particular the test run showed decided improvements in acceleration over calculated performance. The test train, which weighed approximately 1,500 tons, attained a speed of 70 m.p.h. in 12.5 min. over a distance of 11 miles. Calculations made prior to the test indicated that nearly 22 min. for a distance of 20 miles would be necessary to attain this speed.

Supply Trade Notes

CHAS. M. GRANNIS and R. J. Perkins have been appointed service engineers of the Carboloy Company, Inc., Detroit, Mich.

◆

THE BUFFALO BRAKE BEAM COMPANY will, on April 12, move its general offices from 92 Liberty street to 140 Cedar street, New York City.

◆

WILLIAM L. STANCLIFFE has been appointed manager of miscellaneous sales for the American Car and Foundry Company, New York.

◆

W. H. KREER, representative for the Middle West for Templeton Kenly & Company, Chicago, has been appointed sales engineer.

LEO F. HUNDERUP, assistant general manager of the Van Norman Machine Tool Company, Springfield, Mass., has been elected a vice-president of the company.

◆

GILBERT E. WEBSTER, has been appointed sales manager of the track spring washer department of the National Lock Washer Company, with headquarters at Newark, N. J.

◆

LEIGH B. BLOCK, assistant vice-president and assistant manager of sales of the flat rolled steel division of the Inland Steel Company, Chicago, has been elected vice-president in charge of purchases, to succeed E. J. Block, deceased.

DAVID DASSO has resigned his position as vice-president of the American Locomotive Company, Diesel Engine Division. Mr. Dasso will be retained in a consulting capacity by the Locomotive Company and will also continue in the position of United States representative of Sulzer Brothers, Ltd., Winterthur, Switzerland.

◆

E. K. GOLDSCHMIDT, representative at Philadelphia, Pa., of The Safety Car Heating and Lighting Company, has been transferred to its western district, with headquarters at Chicago, and R. L. Hillpot and Pearce Whetstone have been appointed representatives with headquarters at Philadelphia, Pa.

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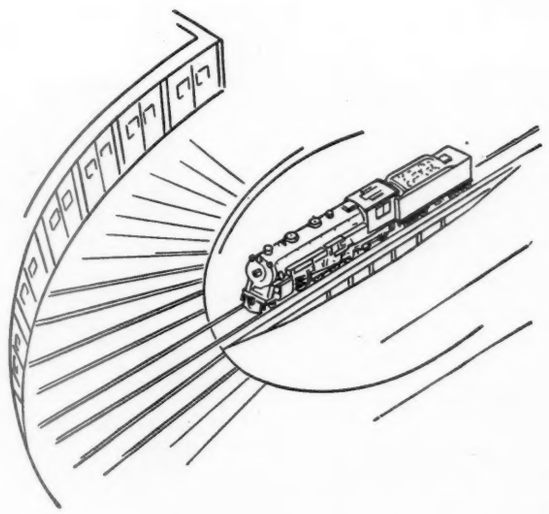
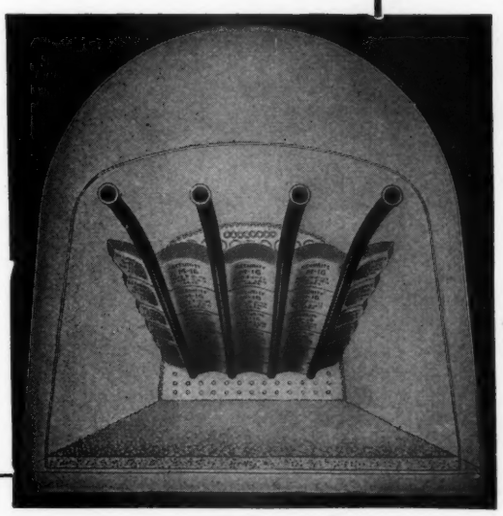
BE SURE
No Arch Brick
Is Missing





There's More to **SECURITY ARCHES** *Than Just Brick*

In these days of rigid economy, don't draw the line too fine and let a locomotive leave the roundhouse with an imperfect Arch due to lack of supplies.

A single missing Arch Brick has a mighty serious effect on steaming and on the efficiency of the locomotive.

Today, a dollar's worth of fuel means more than ever before. To spend it effectively, every Locomotive Arch should be maintained in perfect condition.

Be sure your stocks on hand are ample to provide fully for all locomotive requirements, so that locomotive efficiency will not suffer.

HARBISON-WALKER REFRACTORIES CO.

Refractory Specialists

AMERICAN ARCH CO.
INCORPORATED
60 EAST 42nd STREET, NEW YORK, N. Y.

Locomotive Combustion Specialists

H. A. MARSHALL, eastern representative, railroad department, of the National Aluminate Corporation, Chicago, with headquarters at New York, has been promoted to assistant to vice-president with the same headquarters.

◆

RALPH F. HEATH, representative of Manning, Maxwell & Moore, Inc., at New Orleans, La., has been appointed sales representative at Houston, Tex., and J. Schuyler, for the past five years connected with the company's Los Angeles, Calif., branch office, is now sales representative at New Orleans.

◆

OLIVER W. SPENCER, sales representative of the Southern Wheel Division of the American Brake Shoe & Foundry Co., at St. Louis, Mo., has been appointed vice-president, with headquarters as formerly at St. Louis. Mr. Spencer entered the

O. W. Spencer

employ of the American Brake Shoe & Foundry Co., in 1923 as a special apprentice at Mahwah, N. J. The following year he was transferred to the sales department at Chicago, and later went to St. Louis as sales representative of the Southern Wheel Company, serving as sales representative until his recent promotion to vice-president, as noted above.

◆

THE UNIT TRUCK CORPORATION, 15 Exchange place, Jersey City, N. J., will, on April 15, open a sales office at 140 Cedar street, New York City.

◆

CHARLES L. EGGLESTON, formerly assistant chief car draftsman of the Southern Pacific, with headquarters at San Francisco, Cal., has been appointed special representative of the United States Rubber Company, Mishawaka, Ind., with headquarters at Chicago, to handle the sale of sponge rubber to the railroads.

◆

MALCOLM W. REED, vice-president in charge of operations of the American Steel & Wire Co., has been appointed chief engineer of the Carnegie-Illinois Steel Corporation, to succeed Sydney Dillon, who has been transferred to the office of the chief engineer of the United States Steel Corporation.

J. T. WHITING, who has been elected president of the Alan Wood Steel Company, Conshohocken, Pa., as announced in the March issue of the *Railway Mechanical Engineer*, received his education as a mechanical engineer at the University of Michigan, from which he was graduated in 1909. In July of that year he entered the metallurgical department of the Illinois

J. T. Whiting

Steel Company at its South Works, South Chicago, Ill., and from there went into the blast-furnace department. He has worked successively for the By-Product Coke Corp. (then managed by the Semet-Solvey Co.), South Chicago; the Federal Furnace Co., South Chicago; the Whitaker-Glesner Co., Portsmouth, Ohio; the Steel & Tube Co. of America, Mayville, Wis., and the Donner Steel Co., Buffalo, N. Y. In September, 1927, he became vice-president and general manager of the Hamilton Coke & Iron Co., Hamilton, Ohio, and on January 1, 1932, was elected vice-president of the Alan Wood Steel Company.

C. E. DAVIS, the newly elected vice-president of the Alan Wood Steel Company,

C. E. Davis

worked successively for the American Sheet & Tin Plate Co., the United Alloy Steel Co., the Central Alloy Steel Company, and the Republic Steel Corporation, before associating with the Alan Wood Steel Company eight years ago. For the past two years he has been assistant to the vice-president. For a year and a half during the World War Mr. Davis was in the U. S. Marine Corps with the A. E. F. in France.

THE ACME MACHINERY COMPANY, Cleveland, Ohio, at a recent meeting elected the following officers: Karl F. Bruch, president; H. N. Anderson, vice-president and general manager; E. P. Bruch, secretary-treasurer. Directors include L. N. Davenport, R. W. Hisey, K. N. Anderson, E. P. Bruch, K. F. Bruch, and D. R. Davies, chairman of the board.

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THE HUNTER MANUFACTURING COMPANY has moved its office from 25 Broadway to 444 Madison avenue, New York City. The company has appointed, as its distributors of the Rex emergency carbide light in the railroad industry, the following companies: The Rails Company, New York and New Haven, Conn.; Industrial and Railroad Supply Company, 310 South Michigan boulevard, Chicago; The Railway Equipment Company, 757 Paul Brown building, St. Louis, Mo., and Moffett & Romig, Hill building, Washington, D. C.

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CHESTER H. BUTTERFIELD, general sales manager of the locomotive equipment division of Manning, Maxwell & Moore, Inc., Bridgeport, Conn., has been elected vice-president and general sales manager

C. H. Butterfield

of the industrial and railroad divisions to fill the vacancy caused by the death of W. P. Bradbury. Mr. Butterfield began work with the company in 1917, in the engineering department of the Hancock Valve plant at Boston, Mass. In 1925, he was appointed sales representative of the railroad division in the New England territory, and four year later was appointed assistant works manager at the Hancock Valve plant. In 1931, Mr. Butterfield became sales manager of the Hancock Valve division and, in 1934, was appointed general sales manager of the locomotive equipment division for all products sold to railroads.

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A. K. HOHMYER, assistant western manager of the Westinghouse Air Brake Company, at Chicago, has been promoted to western manager, succeeding C. D. Foltz, who has retired after 29 years continuous service. H. H. Burns, mechanical expert for the company at St. Louis, Mo., has retired after 33 years continuous service.

Mr. Burns began his career as a locomotive engineman and as an instructor for the International Correspondence Schools.

He entered the employ of the Westinghouse Air Brake Company in 1906, as assistant instructor on the instruction car and was in full charge from 1909 to 1913, when he became mechanical expert.

Mr. Foltz, before entering the employ of the Westinghouse Air Brake Company in 1910, was connected with the railroad business for many years. Beginning work at the age of 15 years as a telegraph operator, he successively served as fireman, engineman and traveling engineer with various midwestern roads. His positions with the Air Brake Company have been: mechanical expert and representative at Salt Lake City, Utah, and Denver, Colo., assistant western manager at Chicago and then as western manager.

Obituary

CORNELL S. HAWLEY, president of the Consolidated Car-Heating Company, Inc., Albany, N. Y., died on February 26, at his home in Albany, at the age of 70 years.

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GEORGE W. WILDIN, former general manager of the New York, New Haven & Hartford and former general manager of the Westinghouse Air Brake Company, died at his home in Pittsburgh, Pa., on February 28, at the age of 69. Mr. Wildin was born in Decatur, Ill., and attended Kansas State Agricultural College (B.S. 1892). Entering railroad service with the Atchison, Topeka & Santa Fe in 1892 as mechanical draftsman, he advanced steadily and, in 1901, became mechanical engineer of the Central of New Jersey. From 1904 to 1907 he was assistant mechanical superintendent and mechanical superintendent of the Erie, becoming assistant superintendent motive power of the Lehigh Valley in 1907. Mr. Wildin was appointed mechanical superintendent of the New York, New Haven & Hartford in 1907; general mechanical superintendent in 1916, and general manager in 1917. The following year he was appointed general manager of the Locomotive Stoker Company, Pittsburgh, and from 1918 to 1926, was general manager of the Westinghouse Air Brake Company, at Wilmerding, Pa. He then served as assistant vice-president of that company and of the Westinghouse Friction Draft Gear Company.

George W. Wildin

Mr. Wildin later was connected with the Cardwell Westinghouse Company. Leaving this organization in 1931, he opened an office in Pittsburgh and retained his connection with the Westinghouse Air Brake Company in a consulting capacity. Mr. Wildin was affiliated with several engineering and railway organizations. He served as president of the former American Railway Master Mechanics' Association from 1909 to 1910, and was a past president of the New York Railroad Club and of the Railway Club of Pittsburgh.

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CHARLES A. TERRY, honorary vice-president of the Westinghouse Electric & Manufacturing Co., died on February 18 at his home in New York, after a brief illness, at the age of 80 years. Mr. Terry joined the Westinghouse Electric & Manufacturing Co. in 1888, and served as vice-president from 1909 until April 29, 1931, when he became honorary vice-president.

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EMANUEL J. BLOCK, vice-president and a director of the Inland Steel Company, Chicago, died of a heart attack at Phoenix, Ariz., on March 5. Mr. Block was born at Cincinnati, Ohio on May 22, 1880, and since 1901 has been identified with steel manufacturing. In that year he entered the employ of the Inland Steel Company, and during his 38 years service with that company held positions in various departments, including that of assistant secretary and assistant treasurer. For a number of years he had been in charge of the company's purchasing.

Personal Mention

General

FLOYD R. MAYS, general superintendent of equipment of the Illinois Central at Chicago, has been appointed general manager, with the same headquarters.

G. C. CHRISTY, superintendent of motive power of the Illinois Central, has been appointed general superintendent of equipment, with headquarters as before at Chicago, succeeding Floyd R. Mays.

A. B. WILSON, master mechanic of the Coast division of the Southern Pacific at Bayshore, Calif., has been appointed assistant superintendent of motive power, with headquarters at the Sacramento general shops, Sacramento, Cal., a newly created position.

S. M. HOUSTON, master mechanic of the Western division of the Southern Pacific at West Oakland, Calif., has been appointed to fill the newly created position of assistant superintendent of motive power, with headquarters at the Los Angeles general shops, Los Angeles, Calif.

Master Mechanics and Road Foremen

L. T. FIFE, master mechanic of the San Joaquin division of the Southern Pacific at Bakersfield, Cal., has been transferred to the position of master mechanic of the Coast division, with headquarters at Bayshore, Calif., succeeding A. B. Wilson.

R. E. HARRISON has been appointed master mechanic of the Southern Pacific at West Alameda, Calif., succeeding L. A. Mitchell.

E. R. AUTON has been appointed assistant master mechanic of the Southern Pacific, with headquarters at West Oakland, Calif., succeeding E. E. Hinchman.

L. A. MITCHELL has been appointed master mechanic of the Western division of the Southern Pacific, with headquarters at West Oakland, Cal., succeeding S. M. Houston.

R. H. COLEMAN, assistant road foreman of engines of the Logansport division of the Pennsylvania, has been transferred as assistant road foreman of engines to the Ft. Wayne division, with headquarters at Ft. Wayne, Ind.

C. J. SEARS, assistant road foreman of engines of the Ft. Wayne division of the Pennsylvania at Ft. Wayne, Ind., has been transferred as assistant road foreman of engines to the Logansport division with headquarters at Logansport, Ind.

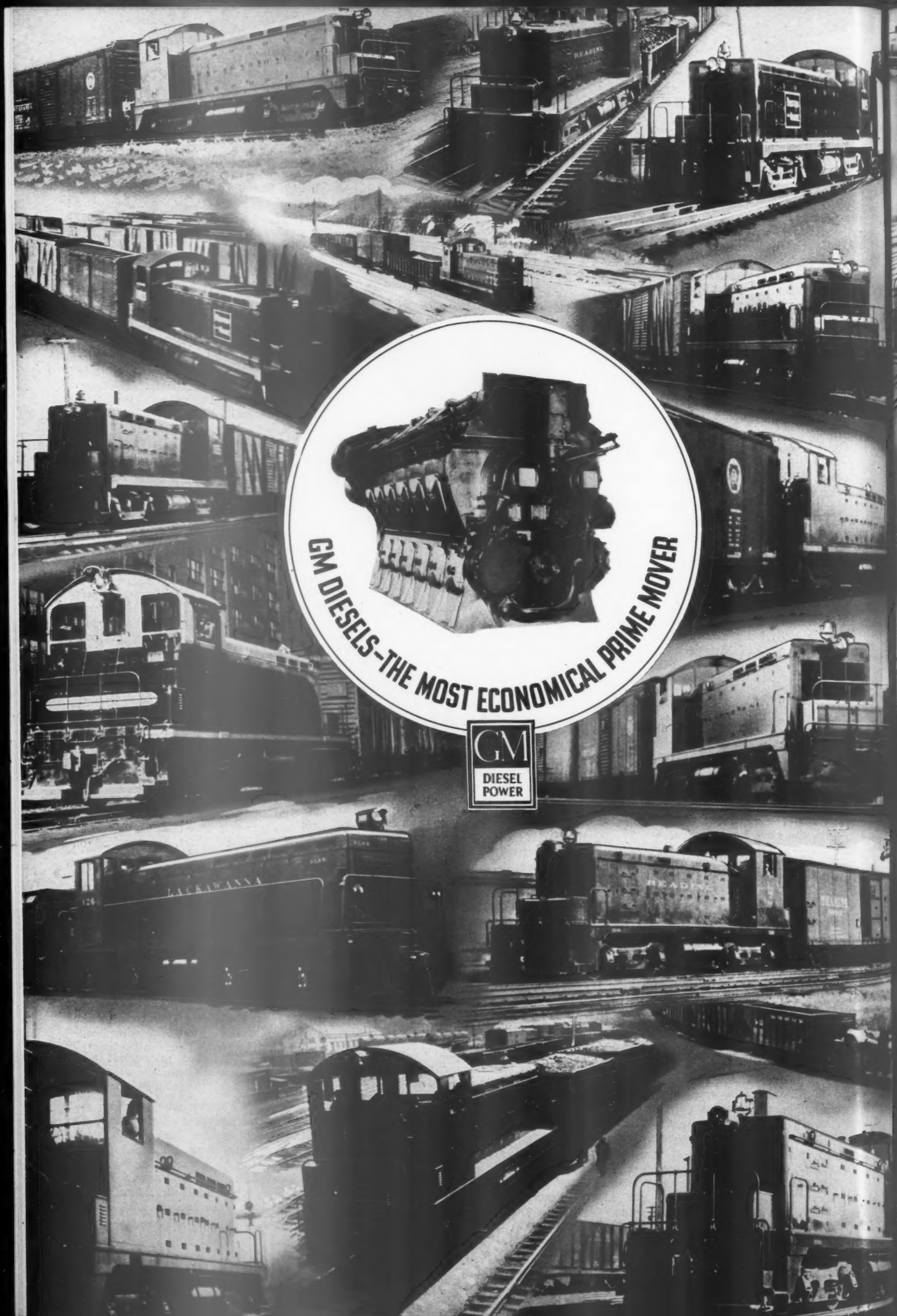
C. S. YOUNG, road foreman of engines on the Missouri Pacific, with headquarters at North Little Rock, Ark., has been promoted to general road foreman of engines, with headquarters at St. Louis, Mo. succeeding E. R. Lockhart, who retired on March 1.

E. HINCHMAN, assistant master mechanic of the Southern Pacific at West Oakland, Calif., has been appointed master mechanic of the San Joaquin division, with headquarters at Bakersfield, Calif., replacing L. T. Fife.

R. E. DETRICK, enginehouse foreman of the Chicago, Rock Island & Pacific at El Reno, Okla., has been promoted to the position of master mechanic, with headquarters at Dalhart, Tex., succeeding C. F. McWilliams, who has been assigned to other duties.

ARTHUR H. FIEDLER, who has been appointed master mechanic of the Fargo division of the Northern Pacific with headquarters at Jamestown, N. Dak., as announced in the February issue, was born on January 24, 1884, at Fargo. He attended high school at Butte, Mont., graduating in 1902. On June 3, 1903, he be-

(Continued on next left-hand page)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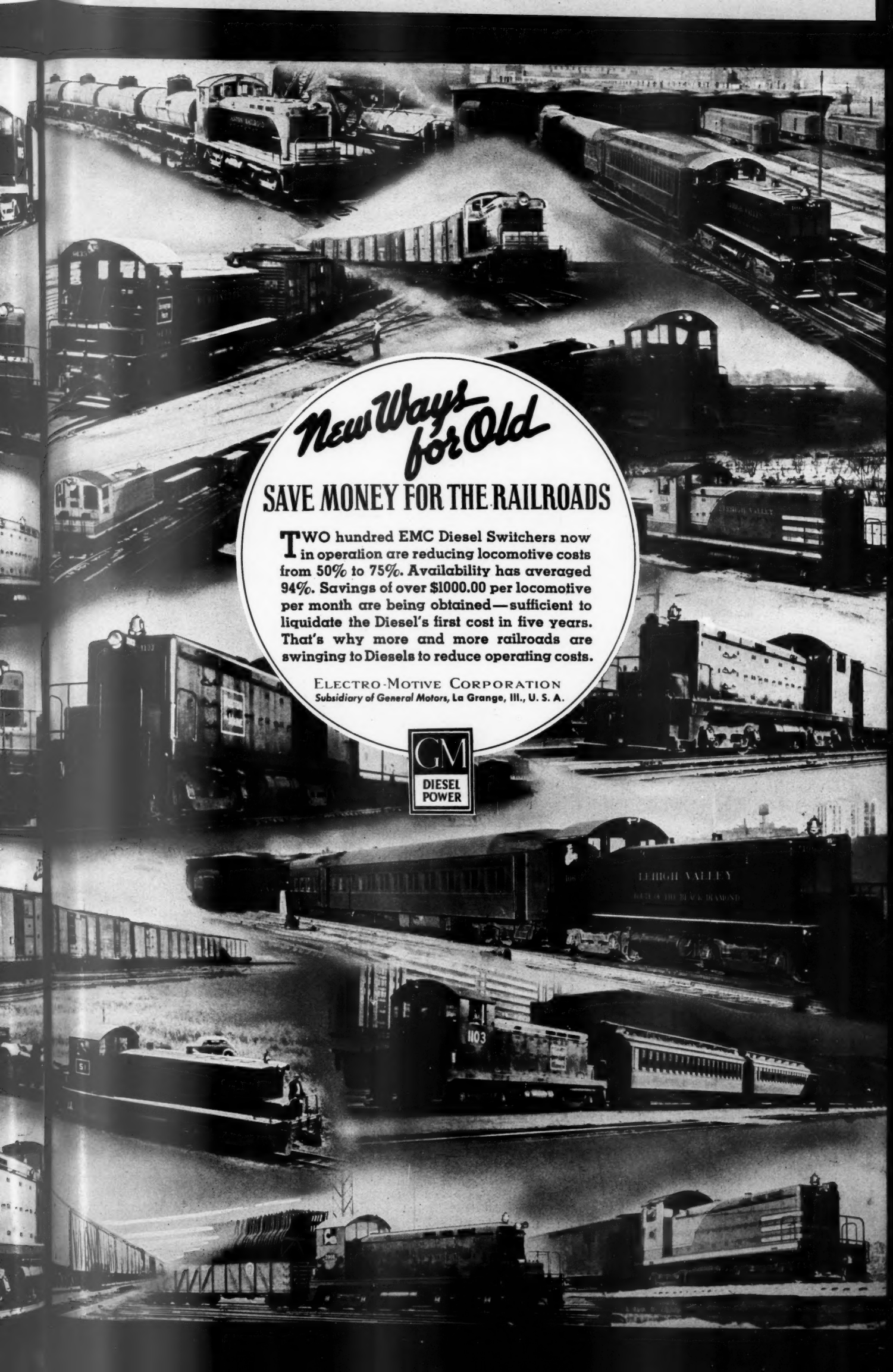
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came storeroom clerk on the Northern Pacific. From September, 1904, until September, 1907, he was a locomotive fireman. From the later date until May, 1934, he

A. H. Fiedler

served as a locomotive engineman, becoming road foreman of engines in May, 1934, and master mechanic in February, 1939.

Shop and Enginehouse

WILLIAM J. MURPHY, foreman boilermaker of the Pennsylvania at Olean, New York, has retired after 50 years' service.

N. J. WHITWORTH has been appointed night enginehouse foreman of the Atlantic Coast Line at Sanford, Fla.

LACY W. REGISTER, enginehouse foreman of the Atlantic Coast Line at High Springs, Fla., has retired.

O. T. ELLIOTT, night enginehouse foreman of the Atlantic Coast Line at Emerson shops, Rocky Mount, N. C., has become day enginehouse foreman with the same headquarters.

WILLIAM MCCAULEY, road foreman of engines of the Monongahela division of the Pennsylvania at Uniontown, Pa., has retired after 52 years' service.

Obituary

C. S. PATTON who retired on May 18, 1936, as general superintendent of motive power of the Seaboard Air Line at Norfolk, Va., died in Norfolk on January 13. Mr. Patton was born on April 4, 1871, at Telford, Tenn., and was educated in the schools of that city. He entered railroad service with the Norfolk & Western in September, 1892, at a brakeman. He was later appointed fireman and from February, 1897, to November 20, 1901, he served as an engineman. Mr. Patton entered the service of the Seaboard Air Line as an engineman on the latter date, and in February of the following year he was promoted to road foreman of engines. He became trainmaster in August, 1905, and six years later was appointed master mechanic. In September, 1916, he was promoted to superintendent, and in July, 1918, was appointed superintendent of motive power. On September 6, 1929, he was appointed general superintendent of motive power.

CHARLES ELLSWORTH CHAMBERS, who retired as superintendent of motive power and equipment of the Central of New Jersey on October 1, 1933, died on March 20, at his home in Roselle, N. J., after an illness of six months. Mr. Chambers was born on October 18, 1865, at Augusta, Ill., and entered railroad service on July 5, 1885, with the Chicago, Burlington & Quincy, serving first in the bridge and building department and then as fireman and locomotive engineman. From 1901 to 1902 Mr. Chambers was road foreman of engines for the Reading, and from the latter dater until December, 1918, was, successively, general road foreman of engines, master mechanic, general master mechanic, and superintendent of motive power of the Central of New Jersey. Under the United States Railroad Administration, Mr. Chambers served as mechanical assistant to the regional director of the Alleghany region at Philadelphia, Pa. He was appointed superintendent of motive power and equipment of the Central of New Jersey in 1920 and served in that capacity until his retirement. Mr. Chambers was a past president of the New York Railroad Club. He was president of the Master Car Builders' Association from 1916 until 1918, when this

C. E. Chambers

association and the Master Mechanics' Association were merged as a section of the American Railway Association. He then served until 1919 as first chairman of the Mechanical Division.

JOHN FRANCIS SHEAHAN, former mechanical engineer of the Atlanta, Birmingham & Coast, died in Atlanta, Ga., on February 22. Mr. Sheahan was born on November 21, 1863, at Glyn, Limerick County, Ireland, and attended Franklin Institute, Philadelphia, Pa., and Mechanics Institute, Rochester, N. Y. He entered railroad service in 1880 as an apprentice and machinist on the Pennsylvania and served successively in the mechanical departments of the Camden & Atlantic (Pennsylvania); Buffalo, Rochester & Pittsburgh (Baltimore & Ohio); Orange Belt (now Atlantic Coast Line); Plant system (A. C. L.); Southern; International-Great Northern, and the Georgia & Florida. From 1912 to 1922 Mr. Sheahan was superintendent motive power of the Atlanta, Birmingham & Atlantic (now Atlanta, Birmingham & Coast). In 1923 he was appointed mechanical engineer of the latter road. In 1933, he retired.

Trade Publications

Copies of trade publications described in the column can be obtained by writing to the manufacturers. State the name and number of the bulletin or catalog desired, when mentioned in the description.

POWER JACK.—The Duff-Norton Manufacturing Co., Pittsburgh, Pa. Four-page illustrated bulletin descriptive of the new Duff-Norton power jack with the new rotary motor for car and locomotive repair service.

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ROLLED STEEL STRUCTURAL SECTIONS.—American Iron and Steel Institute, 350 Fifth avenue, New York. Steel Products Manual; price, 15 cents. Definitions and classifications of rolled-steel structural sections of carbon and alloy steels.

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"STEEL HORIZONS."—Allegheny Ludlum Steel Corporation, Pittsburgh, Pa. A new bimonthly house organ designed to present timely and factual information both for the fabricator and ultimate user of steel alloys.

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LANDIS PRODUCTS. — Landis Machine Company, Inc., Waynesboro, Pa. Bulletin No. A-87-1—Landis chaser grinders and chaser grinding fixtures. Bulletin No. F-80-3—Landis line of hardened and ground die heads.

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WELDING ELECTRODES AND ACCESSORIES. —The Lincoln Electric Company, Cleveland, Ohio. 36-page Bulletin 401-A, "Arc Welding Electrodes & Accessories with Procedure for Welding of Various Metals," printed in color.

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WROUGHT IRON WELDING; BYERS PRODUCTS.—A. M. Byers Company, Pittsburgh, Pa. "The Welding of Wrought Iron," a completely revised bulletin containing practical information for service engineers, also a 56-page catalog of mechanical information on Byers products.

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DEVILBISS HOSE.—The DeVilbiss Company, Toledo, Ohio. Catalog Hd. Describes DeVilbiss line of hose for all requirements and traces its development from the baled crude rubber, through the factory and testing laboratory to its finished forms.

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FASTENING DEVICES.—Parker-Kalon Corporation, 200 Varick street, New York. 68-page, wire-bound catalog-data book. Illustrates and describes the different Parker-Kalon self-tapping screws, explains how and where they are being used, and gives details about other Parker-Kalon fastening devices and specialties.

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METAL HOSE AND TUBING. — Flexible Metal Hose and Tubing Institute, 150 Broadway, New York. 20-page booklet entitled "The Fact Book of Flexible Metal Hose and Tubing," listing and illustrating principal types and forms of flexible metal hose and tubing for the information of design engineers and users.